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VIEWS, NEWS AND INTERVIEWS.

In an address by Thomas Morris before the Staffordshire, England, iron and steel works' managers on the remarkable achievements that have been reached in the manufacture of fine wire, the interesting fact was mentioned that the lecturer had been presented by Warrington, the wire manufacturer, with specimens for which some $4.32 per pound were paid, or more than $8,600 per ton—drawn wire, largely used in the construction of piano and other musical and mechanical instruments. Among these specimens also was pinion wire, at a market price of $21.60 per pound, or $43,200 per ton. It took 754 hair springs to weigh an ounce of 437½ grains; 27,000,000 of these were required to make a ton, and, taking one to be worth one and one-half cents, the value of a ton of these cheap little things ran up to over $400,000. The barbed instruments used by dentists for extracting nerves from teeth was even more expensive, representing some $2,150,000 per ton.

If we place two clocks on the same shelf and adjust their pendulums to swing in exact unison, and set one of them to running, in the course of time the other will start up in sympathy, says Prof. Elisha Gray in the Chicago *Times-Herald*. Each sound impulse caused by the vibration of the pendulum of the clock that is running is communicated to the other pendulum. Each successive impulse adds to the swing of the sympathetic pendulum, which began in an exceedingly small way at the very first stroke of the other pendulum, and this goes on till the sympathetic pendulum is making its full stroke. So with the sympathetic tuning forks. Each air wave that is sent out by the initial fork strikes the other fork and causes at first a slight vibration which accumulates, because each successive air wave strikes the sympathetic fork just at the end of its swing and works in harmony with the natural tendency of the fork to vibrate. The result is a co-operation. Each helps the other. How much better it would be for the world if men would take pattern after this law of physics.

James Mills Pierce, dean of the faculty of arts and sciences, of Harvard University, has given notice that on the recommendation of the faculty the corporation and board of overseers have instituted a degree of master of science, and have committed the administration of this degree to the faculty of arts and sciences subject to all the regulations relating to degrees contained in the statutes, with the understanding that the degree shall be maintained for the promotion of advanced study in some special field of science, and that it shall never be given as an honorary degree. The conditions of admission to candidacy for the degree and the requirements for it will be announced later. In the meantime, students who wish to become candidates for the degree are advised to make special application to the faculty.

A Wilmington, Del., firm of car builders is shipping 30 electric railway cars to Buenos Ayres, Argentine, South America, for the railways in that city. Each car is 30 feet long, of standard width, and similar to the Summer cars used on the railways here. The cars are mounted upon Peckham motor trucks, and are fitted with General Electric motors and controllers.

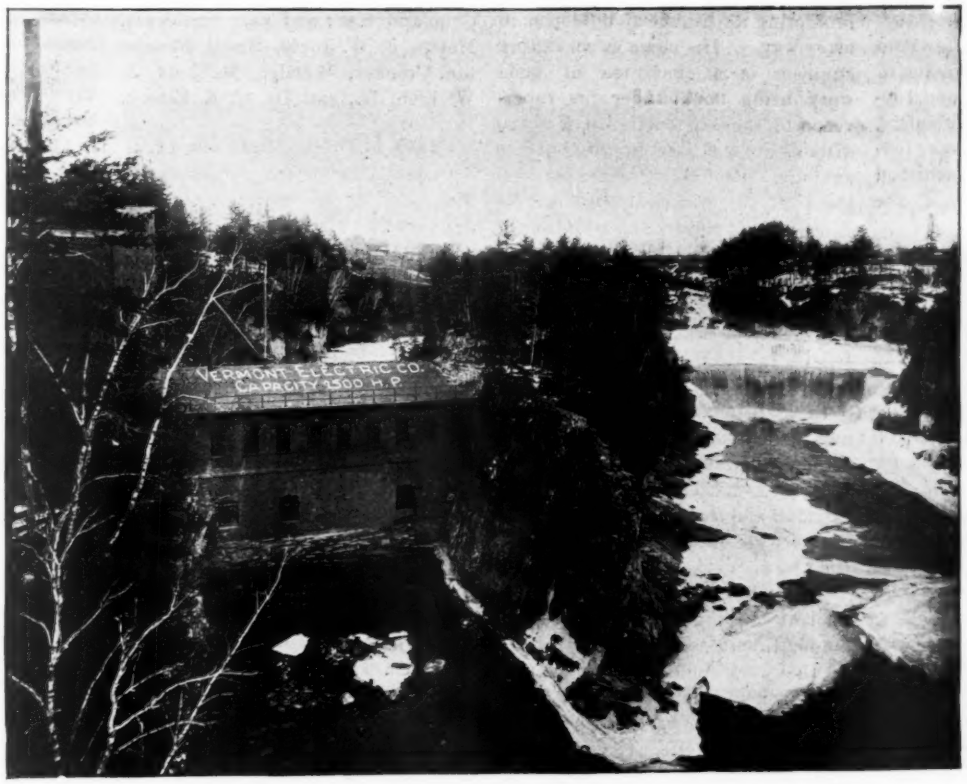


FIG. 1.—THE VERMONT ELECTRIC COMPANY'S POWER PLANT.

The Vermont Electric Company.

The Winooski River, which flows across northern Vermont and played so prominent a part in the history of the state during the French and Indian wars, is now destined to hold a no less important place in its industrial development.

Between Essex Junction and Burlington, about two miles from the latter place, the river has cut an immense gorge through the rocks nearly 100 feet in depth. Just at the head of this gorge the stream divides, leaving a high, rocky island in the center. At this point, the Vermont Electric Company have installed one of the most substantially built and finely equipped electrical plants in New England.

The dam, which is 204 feet long, 31 feet high, and 60 feet thick at the bottom (with an apron 12 feet wide extending across the top), is built of wood and stone, 700,000 feet of hemlock timber being used for the crib, which is filled with stone. A large reservoir is thus formed, furnishing abundance of water, even in the driest seasons of the year, and giving a maximum head of 40 feet.

There are at present three turbine water-wheels developing an aggregate of 1,600 horse-power, and openings in the dam for five more wheels of 600 horse-power each, which will be added as required.

The power-house is 115 feet by 60 feet and is built of stone and iron set on a solid masonry foundation, extending across the stream, and is a model of arrangement; so smoothly does every part work that very little vibration is perceptible even when the entire plant is in operation. Extending the entire length of the upper story of the power-house is a seven-inch steel

shaft 210 feet long, to which the turbines are belted by 52-inch belts, and from which are belted two 225-kilowatt Westinghouse three-phase generators (2,500-volt primary, 250-volt secondary); two 2,000-light Thomson-Houston alternators (2,000-volt primary, 104-volt secondary),and five 60-light Brush arc dynamos. Each dynamo is provided with a voltmeter and ammeter and an automatic circuit governor. The switchboards are of skeleton pattern, made of iron and marble provided with down-pull knife switches, and so arranged as to connect the dynamos in series or to any circuit desired. The several circuits after leaving the dynamos pass out of the power station through a tall cupola to the poles.

To provide for any emergency that might occur by the breaking-down of the water-power plant,a steam plant has been installed consisting of three 125-horse-power and one 150-horse-power horizontal tubular boilers, connected to a 500-horse-power engine. Light and power are furnished for the city of Burlington and the village of Winooski.

Two hundred and fifty arc, 6,000 incandescent lights and 37 motors developing 350 horse-power are used at present, with a probability of more motors and of larger capacity being added soon. No small amount of credit is due the Vermont Electric Company, and especially its general manager, Dr. Walter S. Vincent, for the successful installation of this plant, as it really was the pioneer to demonstrate in Vermont that electricity could be successfully generated by water-power and transmitted for commercial purposes.

Capital is finding these forms of investmeht to be both safe and remunerative, and it is safe to predict that in 1898 Vermont will see marked advancements in electrical development.

A New Commissioner of Patents Nominated.

President McKinley has sent to the Senate the nomination of Charles H. Duell, of New York, to be Commissioner of Patents. Mr. Duell was born in Cortland, N. Y., in 1850. His father, R. Holland Duell, was for four terms Representative in Congress, and was appointed by President Grant in 1875 Commissioner of Pensions. Charles H. Duell practiced law in New York city from 1872 until 1880, when he moved to Syracuse. In 1878 and 1880 he represented the Thirteenth Assembly District of New York city in the Assembly.

Important Electrical Exhibition Arrangements.

Aside from the fact that large amounts of space are now being taken up for the Electrical Exhibition, to be held next May, and that the flow of applications is such as to exhaust every possible and available square foot, a great deal of other preliminary work is going quietly. A very important and interesting piece of news is the acceptance by Prof. F. B. Crocker of the position of consulting engineer, on invitation of the management, which is desirous of associating with itself all that is best in regard to the technical side of the art. Professor Crocker, who regards the exhibition as a highly useful means of reaching the public, is deeply interested in its success, and wishful of promoting its beneficial influence in every way. His name as consulting engineer is a guarantee of good work being done under his supervision by the construction staff in the disposition and safe-guarding of the exhibits. Professor Crocker, as president of the American Institute of Electrical Engineers and professor of electrical engineering at Columbia University, represents the highest technical skill known in the profession; and the exhibition management felicitates itself upon the valuable acquisition.

In addition to this an auxiliary and educational committee has been formed to take general charge of exhibition matters other than commercial, and to co-operate with the advisory committee which represents the New York Electrical Society. The auxiliary committee comprises men of the highest standing, all of whom intend to take an active part in the work, and are now making extensive and interesting plans, of which news will be published from time to time. Mr. T. C. Martin, who was chairman of the very successful committee of the 1896 show, has again consented to serve in the same capacity. With him are associated Prof. F. B. Crocker, of Columbia University; Prof. Morris Loeb, of the University of New York; Prof. W. E. Geyer, of the Stevens Institute of Technology; Dr. Chas. A. Doremus, of the College of the City of New York; Mr. Herbert Laws Webb, of the New York Telephone Company; Mr. J. B. Taltavall, editor of *Telegraph Age;* Dr. Park Benjamin; Secretary G. H. Guy, of the New York Electrical Society; Mr. W. T. Wheeler, vice-president and national deputy, National Association of Stationary Engineers; Lieut. G. O. Squier, U. S. A., and Mr. Thos. A. Edison, Jr., (who is in charge of some special decorative and mechanical effects). It is believed that this committee, enjoying as it undoubtedly will the heartiest confidence and co-operation of all, will be able to accomplish some extremely useful and memorable work in behalf of the science and industry.

As already announced, the New York Electrical Society is the body under whose auspices the exhibition is to be held, and it has appointed an advisory committee entrusted with its interests and composed of its present officers and past presidents; namely, present officers: Dr. M. I. Pupin, president, and Messrs. Dunn, Sinclair, Case, Osterberg, Guy, Riker, Coho and Ker; and past presidents, Messrs. F. W. Jones, Small, Pendleton, Crocker, Wetzler, Mailloux, J. W. Lieb, Jr., and Dr. C. E. Emery.

Death of O. B. Shallenberger.

Oliver Blackburn Shallenberger died at Colorado Springs, Col., on January 23. He was the first to demonstrate in this country, with the aid of George Westinghouse, the efficiency and safety of the alternating current. Mr. Shallenberger was born at Rochester, Beaver County, Pa., in 1860. He was graduated from the Naval Academy at Annapolis, but in 1884 resigned from the navy and began his electrical work at Pittsburgh.

He invented many things in the course of his electrical career of fourteen years. Many of the efficient devices for central lighting stations were originated by him. In power transmission work he rendered aid of practical value. His electric meter is known the world over. It was adopted by the British Government Board of Trade as the standard instrument for accurate measurement of electric currents.

Since 1891 Mr. Shallenberger had worked chiefly at his own laboratory in the town where he was born, acting as consulting electrician for the Westinghouse Electric Company. He spent a good deal of time lately in Colorado, hoping to obtain relief from consumption. At the time of his death Mr. Shallenberger was greatly interested in the construction of the Colorado Electric Power Company's plant at Canon City, Colo., which is to generate current for transmission to Cripple Creek, 25 miles away. He is survived by his wife, a son and a daughter.

ELECTRIC LIGHT FLASHES.

A receiver has been asked for the Gatesville, Tex., electric light plant.

The Shuttleworth electric works, of Frankford, Pa., have been damaged by fire to the extent of $8,000.

The Guthrie, Okla., electric light plant has been sold to J. W. Bedle, of Lacey, Minn., and J. O. Severns, of Guthrie. The plant is valued at $30,000.

The Edison Electric Light Company of Topeka, Kas., has bought the plant of the Brush Electric Light Company. This gives the Edison company a monopoly in Topeka.

The annual report of the Holley Electric Company shows the following: The gross earnings the past year were $3,459.06. The operating expenses were $2,825.65; improvements on plant, $243.13, leaving a net profit of $389.38, of which $250 have been applied to payment on bonded indebtedness.

At the annual meeting of the stockholders of the Scranton, Pa., Illuminating, Heat and Power Company, the following were chosen directors: Franklin Howell, Walter Briggs, Fred C. Hand, Theodore G. Wolf, all of Scranton; C. W. Wisner, Henry W. Darling, New York, and Edward D. Mullen, of Philadelphia.

The report of the Edison Electric Illuminating Company of New York shows as follows:

December.	1897.	1896.	Increase.
Gross	$286,740	$246,275	$40,465
Net	157,410	133,119	24,291
Deprec. charge	12,000	11,958	42
Balance	145,410	121,161	24,249
Int. on bonds	27,075	27,075	.....
Bal. for div	118,335	94,086	24,249
Year ended Dec 31.			
Gross	$2,492,371	$2,247,458	$244,933
Net	1,267,230	1,094,350	172,880
Deprec. charge	144,000	125,872	18,128
Balance	1,123,230	968,478	154,752
Int. on bonds	325,000	325,000	.....
Bal. for div	798,230	643,478	154,752

A new company, with $15,000,000 capital, is in process of formation to buy the control and to consolidate the management of the electric lighting companies in Philadelphia, of which there are six, independent of the Edison-Pennsylvania. The plan comprehends the issue of $15,000,000 debenture bonds at five per cent, in exchange for the capital stock of the companies, the preferred stockholders of the Pennsylvania Heat, Light and Power Company to receive bonds in the ratio of 66⅔ per cent of the par of their holdings, and the common stockholders 24 per cent. The par of both classes of stock is $50, but they are not yet full paid. The plan is not thoroughly matured yet, but eventually it will probably effect a consolidation of all the lighting interests in the city, the promoters of it being associated closely with the United Gas Improvement Company, which recently leased the gasworks of the city.

The Armington & Sims Engines.

After a temporary shut-down the modern works at Providence, R. I., that were for so many years devoted to the building of the Armington & Sims engines, have resumed operations. Probably no engine manufactured is more widely known to the electrical field. There are over 5,000 in successful operation at the present time. The improved engine now being manufactured embodies many valuable features, and is up to date in design. These engines are especially adapted for electric lighting and electric railway work, as well as for heavy-duty service generally.

Mr. Fred N. Bushnell, experienced in electric light and power work, is the manager of the manufacturing organization of the Armington & Sims Company. Mr. W. F. Haring, the well known engine dealer, of New York, will actively represent the company with headquarters in the Havemeyer Building in this city. Mr. Haring is an old-time representative of these engines, knows well their many excellent qualities, and is naturally the man to represent the company at this point.

Mr. Bushnell is preparing new catalogues, which will be ready for distribution in another week, and power stations will do well to send for one.

The American Stoker.

The modern American stoker is deservedly attracting the attention of all users of coal in the electrical field. The saving in time and labor effected by the modern apparatus of this company is a feature that appeals to every central station and power station manager.

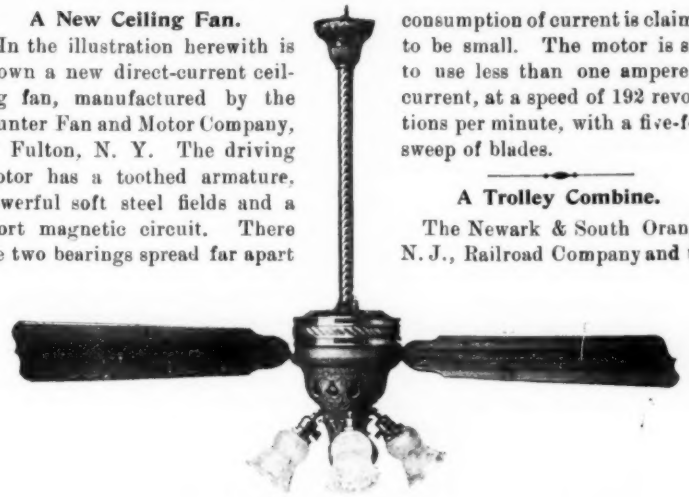
The American Stoker Company is now located in the Garfield Building, Brooklyn, N. Y., under new and energetic management. It will be a distinct advantage to every one interested to send for the catalogues and general descriptive literature of this company.

A Very Large Storage Battery Contract.

That the electric motor-vehicle has come to stay is evident from the fact that Messrs. Sipe & Sigler, of Cleveland, Ohio, manufacturers of the Willard storage battery, announce that they have just closed a contract, extending over a period of three years, with the Fisher Equipment Company, of Chicago, for Willard storage cells, amounting to $238,000, for motor-vehicle propulsion.

A New Ceiling Fan.

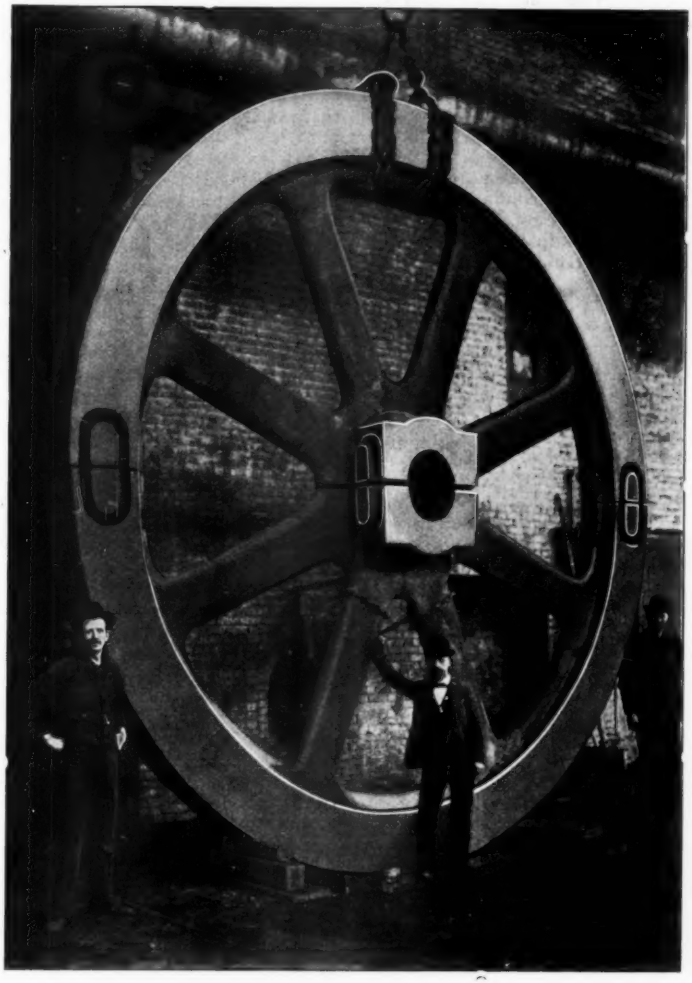
In the illustration herewith is shown a new direct-current ceiling fan, manufactured by the Hunter Fan and Motor Company, of Fulton, N. Y. The driving motor has a toothed armature, powerful soft steel fields and a short magnetic circuit. There are two bearings spread far apart to prevent the armature from rubbing against the poles, as is often the case with a single short bearing after the bearing becomes a little worn. Both bearings are submerged in oil, and there is a two-speed switch on the lower part of the fan. The consumption of current is claimed to be small. The motor is said to use less than one ampere of current, at a speed of 192 revolutions per minute, with a five-foot sweep of blades.



A New Ceiling Fan.

A Trolley Combine.

The Newark & South Orange, N. J., Railroad Company and the North Jersey Traction Company have been consolidated. The new company will control every street railroad in North Jersey not now controlled by the Consolidated Traction Company. The capital of the combined companies amounts to $5,000,000.



An Immense Flywheel Casting.

IMMENSE CASTINGS.

THE LATEST WORK OF THE SESSIONS FOUNDRY COMPANY IN THIS FIELD.

Several noticeable advances toward the perfecting of iron castings have lately been made by the Sessions Foundry Company, of Bristol, Ct. A very successful cast of six flywheels has recently been finished by them for the Providence Steam Engine Company. The wheels are some of the largest ever turned out by the Sessions company, and great care had to be exercised in avoiding flaws usual in castings of such large size. The wheel illustrated, measures in its finished state 18 feet in diameter, and weighs 31½ tons. Steel links are shrunk on each side of the rim, with two additional links on the inside to increase the rigidity of the rim.

In the casting of the wheel ample allowance is made for whatever planing may be necessary in fitting the two halves. The entire wheel is cast and split by cores running through on the center line. By this operation a more perfect joint can be made than is possible by a separate casting for each half of the wheel. The illustration shows the flywheel in its rough state when just taken from the sand. The break at the middle is where the separation is made, and, when planed, the halves are again fitted together by means of the steel links.

In order to insure a perfect cast great care must be exercised in the bedding and fitting of the mould, which is entirely made up of cores. In preparing for the cast a spindle is first placed in the center where the mould is to be set up, and by the revolutions of the sweeps a perfectly hard and level bed is secured. Cores are then securely imbedded in the sand, and the halves of the cores for the arms clamped together by vertical bolts running through ears projecting from the skeleton core arbors. The pouring of the wheel is done entirely at the hub, and the time taken for the pouring is less than two minutes.

The Sessions Foundry Company has one of the largest and most perfectly equipped plants in the country. Situated on the side of the New England Railroad, they have all the modern facilities for shipping goods to any distance desired. By means of a mile and a quarter of special track leading to all parts of the foundry, a direct connection can be made with the railroad, thereby avoiding all likelihood of any delay in the shipment of goods.

PUBLIC CONTROL, OWNERSHIP OR OPERATION OF MUNICIPAL FRANCHISES.*

WITH SPECIAL REFERENCES TO ELECTRIC LIGHTING.†

BY R. R. BOWKER.

(Continued from page 44.)

London.‡—London does not own its water front, except along the "embankments" made during the past generation, and its magnificent system of docks is the work of several different corporations, one of which has a capital of £5,000,000.

London receives its water supply from eight private companies, the oldest dating from 1608, and one other taking water from the river Lea, a third from chalk pits in the hills of Kent, the other five from the upper Thames, filtering the water through large settling pools. Water rates based on rental value must be paid by the tenant in advance; the house owner must lay the pipes communicating with the mains, except for houses renting under $50 per year, for which the company must on request furnish service pipes, charging for them an additional annual charge, in which case the owner is responsible for the water rates. The London County Council desires to take over the water supply, but bills have so far failed because of disagreement as to compensation. The Board of Works, and now the County Council, has safeguarded the interest of the public; no addition to share capital has been allowed since 1878, and the interest on debentures has, since 1894, been limited to a rate that, in the judgment of the Governor of the Bank of England, would secure issue at par. The companies can not pay more than 10 per cent dividend except to make up lower previous dividends; the actual rate has ranged from 5 to 12½ per cent, and the price of the stock ranges from 150 to 420, reducing the actual return to from two and seven-eighths to three and a half per cent on present investment value. Any surplus must be invested as a reserve fund in the hands of the City Chamberlain.

London is supplied with gas from three private companies, under close government regulation. The price is from 2s. 5d. to 3s. 6d. (58 to 84 cents) per thousand cubic feet of gas giving 15 candle-power in a five-foot burner. Meters are tested by County Council officials at a charge of from six pence (12 cents) to three shillings (72 cents) or more, for which the gas company pays if the meter is inaccurate, and the consumer if it is accurate.

London has 10 electric lighting companies and 4 vestry municipal plants, occupying under "Provisional Order" charters, specified districts of London, in some cases exclusive, in other cases with two companies in competition. The price is limited by the Board of Trade to a maximum of eight pence (16 cents) per unit. In practice the base rate of the companies varies from eight pence (16 cents) to six pence (12 cents), not including lamps, with a sliding scale reducing the price as low as four pence for motive-power, or in one case three pence if used during the daytime alone. The share and loan capital together of the 10 companies exceeds £4,500,000. The sales in 1896 exceeded 18,000,000 kilowatt hours, and the returns £450,000, making an average rate of practically six pence (12 cents) per unit, or 6 to 10 cents per 16 candle-power lamp hour, which does not include lamps. The most successful, though not the largest of the London companies, received in 1896 an average price of 5.63 pence (11 cents), and its operating expenses were 3.34 pence (six and three-quarter cents). Of the municipal plants, only that in the parish of St. Pancras is comparable; its investment is about £109,000; its output in 1896 was 850,000 units; its average price 5.34 pence, and its average cost four pence. The other three plants in the parishes of Hampstead, Islington and Shoreditch are small or new. The last, however, has been designed by enterprising private contractors, who have installed a "destructor" plant, utilizing the refuse from the streets for fuel, and a thermal storage apparatus of the Druitt-Halpin method. This plant was put in operation only in 1897, and no figures are yet available. It promises, however, to present one of the most favorable examples of municipal supply in the world. In the small Hampstead municipal plant the average price was 5.54 pence, and the expenditure 7.38 pence, so that the rate-payers paid a third of the actual cost. The Crystal Palace private company also showed a loss.

The new County Council thoroughfares in London are supplied with several miles of subway tunnels, accessible from various points and providing access through manholes to the sewers as well as facilities for all kinds of subway service, including water mains, gas pipes, electric conduits and a hydraulic service for elevators and motor purposes at over 1,000 pounds pressure. From these subways alcove connections are made on either side between each pair of buildings.

Other English Cities—Outside of London there are recorded 18 private electric light companies and 30 municipal plants, the trend being evidently toward municipalization. The largest systems are those of Manchester, a municipal plant which last year produced 1,748,000 units at an average price of 5.25 pence and an average cost of 3.01, or 57 per cent of receipts; Liverpool, a private company, with 1,185,000 output, average price of 7.3 pence and average cost of 3.49 pence, or 47 per cent, and Glasgow, a municipal plant, with 1,090,000 output, at an average price of 5.58 pence and cost of 4.12 pence, or 73 per cent. Birmingham, noted for its municipalization of industries, decided to permit the new industry of electricity supply to go into the hands of a private company for the parliamentary period of 50 years. Of the private companies one, and of the corporations eight, show greater expenditures than receipts, these being mostly small systems, only one having more than £3,000 income. At Blackburn, a municipal plant, the average price is 5.91 pence and the expenditures 10.1 pence, or 171 per cent, so that the taxpayers pay 4.10 pence on every unit sold to consumers. At Dover, a private company, the average price is 4.75 pence and the cost 8.80 pence, or 185 per cent, so that the shareholders pay 3.05 pence toward each unit sold to the consumers. The highest price charged by a private company is 7.76 pence; the highest price charged by a municipal system, 6.50 pence; the highest costs are 10.1 pence at Blackburn, and 8.8 pence at Dover, an excess of costs of 1.3 pence on the municipal plant. The lowest cost is 2.72 pence in the Yorkshire private company, and 2.66 in the Whitehaven municipal plant, a difference of .06 pence—practically the same. Comparisons even here are not accurate, because, though the Board of Trade returns are on closely parallel lines, they are not entirely the same, and the variants of locality can not be considered. The closest comparison possible, perhaps, in the world, is between Manchester and Liverpool; the Manchester municipal plant, though installed so late as 1893, is of an old and almost obsolete type; the Manchester output is 50 per cent greater than Liverpool, and the cost is correspondingly lower. The figures show practically a "drawn game" as between private companies and municipal plants in England.

England has had rival telephone systems, that of the National Telephone Company and that of the government. Competition has been keen. The government system has held but 1,000 out of over 100,000 subscribers. Almost all the government exchanges have been abandoned, and the most important one existing, that of Newcastle-on-Tyne, has but one-third the number of subscribers of the private company. The government postal service was so much affected by the telephone system that Parliament passed a bill authorizing the Post Office to take over the trunk or long-distance lines, so that these lines are now maintained and operated under the direction of the postal authorities, and subscribers between the exchanges of the private telephone system are connected through the government postal lines. It may be mentioned that in Stockholm, where there is like competition between a government and a private system, the private system is also getting the lead.

New York—New York owns most of its water front; its gross dock rentals, amounting in 1895 to $2,084,382, are paid into the sinking fund, but the expenses of the Dock Department, $1,061,597 in 1895, and the interest on dock bonds for $27,053,000, practically offset these. The city, indeed, seems to get less from its docks than if they were private property paying taxes. New York leases ferry privileges each ten years, at public sale, to the highest bidder, who must take over the operating plant at appraisement value—an excellent plan, bringing the city $346,598 rental in 1896.

New York owns and operates its water supply as well as its sewerage system. The water "rates" and meter returns at 10 cents per 100 cubic feet, $3,852,396 in 1895, are paid in gross into the sinking fund, but the expenses on water account, $1,808,264 in 1895, reduce the net revenue to about $2,000,000, which is nearly offset by the interest on outstanding water bonds of $44,126,300. Interest on its full cost not accurately known but estimated at $78,000,000 would show a loss.

New York (Manhattan Island only) has four gas companies, the Consolidated including six former companies, the Equitable including the new East River company, the Mutual with a provision in its charter against consolidation, and the Standard. It is expected that one new company will practically, if not in form, consolidate most of these interests. There have been a number of gas mains in one street. The gas companies publish no statistics of output. The price, as high as $2.25 per 1,000 cubic feet a few years ago, has been reduced by operating improvements, by competition and by legislation to $1.20 per 1,000 feet, the law of 1896 reducing it five cents per year from $1.25 till it reaches in 1901 $1.00. Oil chiefly is used for fuel. When the Edison company began incandescent electric lighting in 1882, gas stocks dropped nearly one-half, but despite all electrical developments, the gas product has increased year by year. The four companies have a stock capital exceeding $53,000,000, and bonded debt above $6,000,000, chiefly at five per cent. The stocks show a market value ranging from $128 to $335, or an excess of $30,000,000 above par, reducing the dividend of 4 per cent to 12 per cent to about 4 per cent on market value.

New York (Manhattan Island only) has seven electric central station systems with 15 generating stations, and

*From *Municipal Affairs*.

†This paper is written from the point of view of the economist and citizen, but with the data and experience gained as the executive of the New York Edison Company. To my mind, this should not involve opposition of interests; as he most serves his party who best serves his country, so he most serves the interest of a public service company who best serves the public. I mention the relationship, however, to forewarn readers of any unintentional bias. It is difficult for any, outside the business cited, in an academic discussion, to obtain real bases of comparison.

‡Whitaker's Almanac, 1897; Dickens's Dictionary of London, 1897; *The Electrician*, Supplement, 29 Jan., 1897; *Lightning*, 25 Mar., 1897; Electricity Up to Date, by J. B. Verity (Warne, 1896).

400 to 500 isolated plants, aggregating probably 660,000 incandescent lamps, 14,500 arc lamps (of which 2,815 are city street lamps), besides 28,500 horse-power in motors, making an equivalent of over 800,000 16-candle-power incandescent lamps, or with motors, over 1,200,000 equivalent. There are as many as five competing conductors on the same thoroughfare. The Edison company controls the Manhattan and Harlem high-tension systems and the United (Westinghouse) company the Brush arc-light system, showing the trend towards consolidation. Only the Edison company prints a report. It has a stock capital of $8,000,000, paying originally four per cent and now six per cent, the market price of $125 making

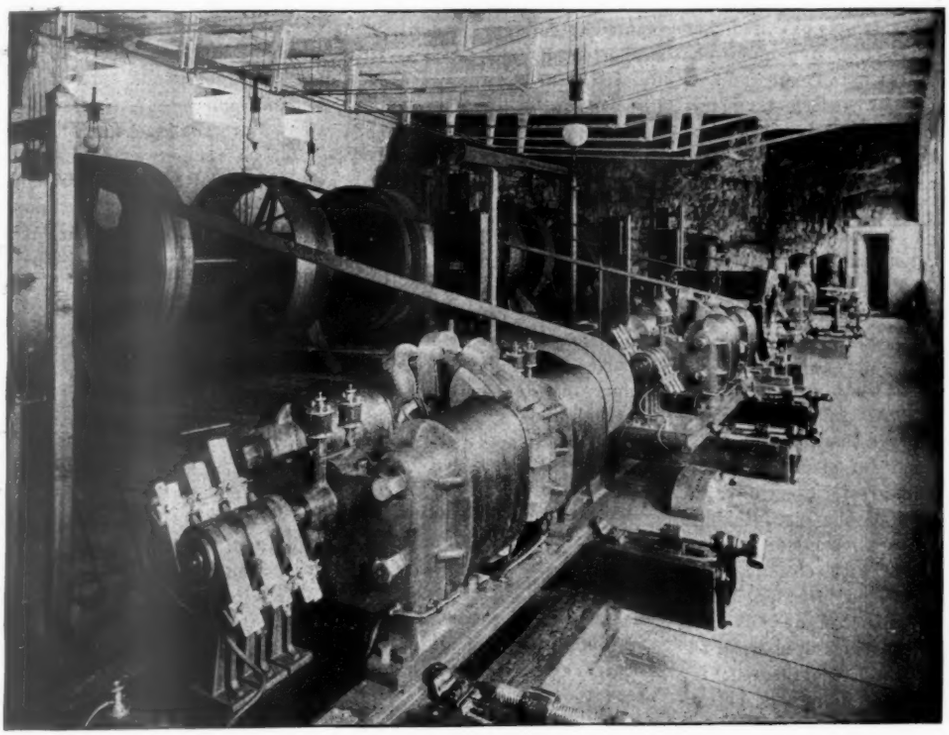


FIG. 2.—INTERIOR VIEW OF THE VERMONT ELECTRIC COMPANY'S POWER PLANT.—(See page 67.)

this five per cent on actual investment cost, and $6,500,000 in bonds, paying five per cent interest. It had (November 30) 7,422 customers, 345,280 incandescent lamps, 4,317 arc lamps and 18,874 horse-power in motors, the equivalent of 673,484 16-candle-power lamps, making it the largest electricity supply company in the world. Its returns in 1895 were $1,771,229, or including the high-tension system, $2,222,737. The base-rate for incandescent electric lighting is one cent per 16-candle-power lamp hour (20 cents per unit), 10 cents per arc lamp hour and 10 cents per horse-power hour, but all these rates are reduced by discounts, and a wholesale base-rate of 10 cents per kilowatt hour is made for general use. The average Edison return in November, 1897, was 8 to 10 cents per 16-candle-power lamp hour for incandescent lighting with, or three to four cents without, lamps, or 11½ cents per unit for all services. New York city pays 40 cents per night for standard arc lights, or $146 per year, being practically four cents per arc lamp hour, 45 cents for like lamps in parks, etc., and 50 cents per pair for the Fifth avenue smaller lights. This price is reckoned to cover little above actual cost, including subway rental, of city lighting to the companies, which get their profit from commercial lighting in the same streets. Small anthracite coal costs in New York about $2.75 to $3 per ton, or "alongside" dock, about $2.25 to $2.50. No electric lighting company other than the Edison has paid dividends, except the Brush company in its earliest years, when the price of city lighting was much higher, and the total share and loan capital of all companies averages much below par.

After Edison in 1882 had proved that electric lighting by underground conductors was feasible, a law was passed requiring all electric wires to be placed in subway ducts. Two subway companies now exist, one for high and one for low-tension conductors, charging a rental prescribed by the Board of Electrical Control, a municipal commission, varying with size of duct; the rental for standard three-inch duct is $1,000 per mile, which when street lighting only is furnished is $50 per year per lamp at the usual distance of 250 feet apart. The Board of Electrical Control reported in 1896, 707 miles of ducts for high-tension conductors, 211 for Edison low-tension conductors, 950 for telephone and telegraph conductors and 56 of ventilating pipe. The city has had the right since January 1, 1897, to take over these ducts, subject to liens and leases, at cost and 10 per cent per year profit (less dividends actually paid), and free ducts must be furnished for the police, fire and other city departments. House connections must be made at the expense of the supply companies, but all ducts built by or for these companies are in the legal ownership of the subway company. Besides this subway system, New York has in its subsoil a steam-heating system and a pneumatic system for the telegraph companies, producing a complexity probably beyond parallel elsewhere. It has also an oil pipe line across the city. New York receives nothing directly for its subsoil privileges except a ridiculous sum, $141 in 1895, from one gas company, and a franchise fee, $2,587 in 1895, for the oil pipe line; but the supply companies, besides paying taxes to city and state, pay also the expenses of the state commissions and boards of control.

The New York street railway system has been in process of consolidation for some years, until now there remain chiefly two great operating companies, the Metropolitan and the Third Avenue company. These are both private corporations, each transferring on its own system within the single fare of five cents. The four lines of elevated railway, originally built by two competing companies, are now consolidated into the Manhattan company. The city has no specific rights of control over these roads, but receives certain license payments per car and other franchise payments from railroads, amounting in 1895 to $352,288.

The new charter for Greater New York makes the rights of the city in its water front, streets, etc., inalienable, and prohibits new franchises for a longer period than 25 years, with renewals optional on the part of the city, aggregating 25 years more. On the termination of a grant, the plant shall become the city's property, either without payment or at valuation, as the grant may prescribe. If the city takes over property without compensation, it may operate the plant or make a new lease, but if compensation be required, the city shall itself operate for at least five years—an unusual and extraordinary provision. Every grant shall provide for efficient service at reasonable rates. The jurisdiction over gas, electricity and like industries passes to the Commissioner of Public Buildings, Lighting and Supplies, and he is required to provide for tests of gas, of meters and of electric wiring. Private consumers may require a test of meters by the official inspector, the consumer paying for the test if the meter is accurate, and the company if it is not.

(To be continued.)

A Universal Exposition at London.

A Universal Exposition will be held, on a very large scale, from May to October, this year, on the magnificent Exposition Grounds of Earl's Court, London, England. The exposition will be under the director-generalship of Mr. Imre Kiralfy, of New York and Chicago fame, and it is intended to illustrate the latest achievements in inventions, manufactures, industries and applied arts.

Important sections will be devoted to the largest manufacturing and producing countries of the world, and considering that it is over 12 years since a Universal Exposition was held in London, and judging from the ever increasing development of American trade during this time, it is expected that American producers and manufacturers will avail themselves of this opportunity to extend their business. The best and most elegant location of the exposition, it is stated, has been reserved to the United States Department, and no pains will be spared by the management in order to afford every facility to American exhibitors.

Mr. A. Macchi, who was a Member of the Board of Judges at the World's Columbian Exposition, Chicago, 1893, and Commissioner at the Exposition at San Francisco, Atlanta, and lately Chief of the Foreign Department at the Tennessee Centennial Exposition, Nashville, 1897, has been appointed Commissioner for the United States, to whom all communications should be addressed, at the Exhibition Grounds, Earl's Court, London, S. W.

Electrical Review

[OLDEST ELECTRICAL WEEKLY IN THE UNITED STATES.]

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SPECIAL NOTICE TO ADVERTISERS.

CHANGES for advertisements must be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week.

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Attorney-General Hancock has decided that the electric railways in New York city are not under the jurisdiction of the Board of Electrical Control or the State Comptroller. The State Board of Railroad Commissioners is the natural authority in the matter, and has been so considered where a change in motive power has been concerned.

TRADE OPPORTUNITIES IN EGYPT.

In no way is the industrial progress of Egypt better illustrated than by the present development of its railway system. Railway building is not a recent innovation in the land of the Nile, however, as the first line, from Alexandria to Cairo, dates from 1852, and five years later the English engineer, Robert Stephenson, completed rail communication between Alexandria and Suez, making the "overland route" to India as practicable for freighting as it had been for passenger traffic. This is now almost wholly superseded by the great canal of De Lesseps. It may be stated that Egypt, in proportion to population, has more railway in mileage and better service than Austria-Hungary, Spain or Portugal. All railways are government property, with the exception of a short suburban road from Alexandria along the Mediterranean to Ramleh, a 15-mile line connecting Cairo with the health resort of Helouan, and a steam tramway on the bank of the Suez Canal, joining Port Said with Ismalia.

The private enterprises, as well as the government lines, are very profitable, and this fact induces the companies to improve their equipment.

The demand for electrical equipments becomes greater every day; the administration of the city of Cairo has just formed a resolution to equip the whole city with electric light, which work will be installed during the present year. Many new railways will be constructed, many of the large sugar factories improved; the majority of the numerous cotton-dressing establishments are going to be equipped with electric light and appliances. The private houses and hotels will, of course, keep pace with this development, and Egypt will doubtless offer a valuable field for all kinds of electrical goods.

It seems, however, that the land of the Nile has never attracted much attention from the United States as far as trade is concerned. About 31 per cent of the total imports come from England, while 35 per cent of the exports go to England.

Egypt imported in 1895 iron, steel and manufactures thereof amounting to a value of about $4,500,000; in 1896 these imports increased to about $6,000,000, to which the United States contributed not more than one-third per cent. At the present moment, when the commercial competition of the world is becoming more and more acute, it behooves those nations wishing to maintain their foothold in the international markets not to despise any country offering opportunities for trade. This is especially true of a nation expecting to extend its trade, as is the case of the United States.

As an example of the activity in the foreign electrical industry it may be mentioned that there has been formed in the city of Berlin a company with a capital of $2,500,000 under the title of "Deutsche Überseeische Electricitäts Gesellschaft" (German Transoceanic Electrical Company). This company has for its object the installation of electric plants in foreign countries, and is supported by the General Electric Company, of Berlin, and some leading German banks. There are also to be held during this year in the cities of Turin, Italy, and St. Petersburg, Russia, international electrical expositions.

Our manufacturers, therefore, must be prepared to meet a strong competition.

Returning to Egypt, Alexandria is the principal port, and almost all imports enter there. Richard Brown & Company are the leading importers, have branches throughout the country and are government contractors.

The National Association of Manufacturers held its annual meeting in New York city last week, and gave a banquet at which President McKinley was the guest of honor. Nearly 1,000 manufacturers from all parts of the country attended the banquet and heard the President deliver an able address, in which he took a strong position on the sound money question. The sessions of the association were conducted in a business-like manner, and many questions of importance to manufacturers were discussed. The association, in three years, has become a very important and influential body.

The increasing prosperity of the electric lighting companies in most of our large cities is an excellent indication that general business is good. Plenty of electric light is an excellent advertisement for the merchant, and he is not sparing of it when his business warrants the outlay.

Geneva, N. Y., it is announced, although a city, will hereafter be lighted by kerosene. This does not speak highly for the progressiveness of its citizens.

WALL STREET AND THE ELECTRICAL STOCK MARKET.

After a general depreciation in values on Monday, following the announcement that the government had ordered the "Maine" to Havana, the stock market began a steady upward movement which culminated at noon, Friday. Interest centered in the Vanderbilt group and Northern Pacific, to be sure, but the general list showed improvement in values and a decided increase in the volume of business. The bond market was especially active, and sales for the month of January to date probably exceed those of the corresponding period in any other year, indicating that capital is eagerly seeking investment, and, owing to the scarcity of gilt-edged bonds, turns to speculative and semi-speculative issues.

With the exception of interchanges of letters between President Gould, of Manhattan, and President Orr, of the Rapid Transit Commission, the local rapid transit situation has undergone no change. The pool in Manhattan stock has been resting, and there were evidences that somebody had stock for sale whenever the price rose above 117. Metropolitan Street Railway, on the other hand, continued to be well bought and sold up to 147⅛, which is the highest price yet recorded for it. The management announces that electric cars will run on Tenth avenue to 125th street after next Sunday, and the company expects to proceed with the equipment of its lines with electricity or the cable as rapidly as possible.

The latter announcement was probably the cause of the report, circulated on the Exchange, that the General Electric Company had received important contracts from the Metropolitan, as a result of which there was increased activity in the stock, and it advanced from 34⅜ on Monday to 37⅛ on Thursday, subsequently declining on the failure of the report to be confirmed. It is stated with authority that the General Electric Company has taken no new contract from the Metropolitan, though business generally is exceedingly good at the moment. The decision in the motor suspension case this week was the only strictly new bull item.

One of the features of the week was the continued activity in North American, which advanced from 4¾ on Monday to 6⅛ on Thursday. Transactions were exceptionally heavy, in furtherance of the plans of certain interests who have been identified with the speculation in the stock

of late. Low-priced securities always appeal to a certain portion of the public, and it is not unlikely that, if the general market should keep strong, higher prices may be attained by North American.

Advices from Philadelphia indicate that a great diversity of opinion exists regarding the proposed consolidation of the electric light companies and the treatment of the common stock. It is stated that as concerns Pennsylvania Heat, Light and Power Company, an exchange will be made in 5 per cent collateral trust bonds of the new company to be formed to control the companies on the basis of 24 for Pennsylvania Heat common and 66 for the preferred. These prices, though showing an increase on both stocks, are said to be too low for the common when the earnings of the Heat company are considered. A bond expert is quoted as saying that the deal would be more equitable if the common stock were taken on the basis of 33 and the preferred at 66, which would be equivalent to a dividend of $1.65 for the common and $3.30 for the preferred. The next regular meeting of the directors of the Pennsylvania Heat company will be held next month. The proposition for the absorption of the company has therefore not been formally acted upon.

The Edison Electric Illuminating Company of Brooklyn reports for the year ended December 31 last an increase of $36,212 in net earnings over 1896. Other income, however, decreased $18,061, and interest and taxes also decreased $6,137, showing an increase of $23,288 in the balance. The dividends during the year amounted to $237,109, or $12,109 more than in 1896. The surplus on December 31 was $79,327, or $12,179 more than in 1896.

Small transactions were recorded of electrical stocks on the Boston Stock Exchange this week. Bell Telephone, from a close last Saturday of 269½, declined this week and closed at 267. Erie Telephone sold down a point to 70 and up to 72 on Friday. General Electric preferred ranged between 89 bid, offered at 92 the early part of the week, with sales at 89 on Friday, and New England Telephone advanced a point from the opening to 131½ at the close.

On the Philadelphia Exchange, Electric Storage Battery stocks were dull and inactive, the common selling at 26¼ to 26¾, and the preferred at 29½. Pennsylvania Heat, Light and Power, on large transactions, gained 1½ points to 22 on Tuesday, later reacting one-half and closing at 21¼ and 21½.

RAY.

Wall Street, January 29.

Judge Wheeler's Decision on the Motor Suspension Patent.

The following is the decision in full of the United States Circuit Court in the case of the Sprague Electric Railway and Motor Company against the Union Railway Company of New York city and others. As is generally known, the patent involved is one granted to Lieut. Frank J. Sprague for a method of suspension of motors on electric railway cars and is now owned by the General Electric Company. The decision is regarded as an important one by the General Electric Company, which considers that the patent covers all methods of suspending motors in electric traction work:

CIRCUIT COURT OF THE UNITED STATES.

SOUTHERN DISTRICT OF NEW YORK.

SPRAGUE ELECTRIC RAILWAY AND MOTOR COMPANY, vs. UNION RAILWAY COMPANY *et al.*	In equity.

This suit is brought upon patent No. 324,892, dated August 25, 1885, and granted to Frank J. Sprague for an electric railway motor consisting of a field magnet journaled on the axle of the driving wheels at one end, and hung upon a spring from the truck, or the car body, at the other, and carrying the armature shaft upon its pole pieces parallel with the shaft of the driving wheels, and connected to them by gearing. The specification as to this arrangement says:

"The armature being carried rigidly by the field magnet, these two parts must always maintain precisely the same relative position under every vertical or lateral movement of the wheels or of the car body; and as the field magnet which carries the armature is itself centered by the axle of the wheels to which the armature shaft is geared, the engaging gears also must always maintain precisely the same relative position. At the same time the connection of the entire motor with the truck is through springs, so that its position is not affected by the moves ments of the truck on its springs."

The claims in question are:

"2. The combination of a wheeled vehicle and an electro-dynamic motor mounted upon and propelling the same, the field magnet of said motor being sleeved upon an axle of the vehicle at one end, and supported by flexible connections from the body of the vehicle at the other end, substantially as set forth.

"6. The combination with a wheeled vehicle, supported upon its axles by springs, of an electro-dynamic motor flexibly supported from such vehicle, and centered upon the driving axle thereof, substantially as set forth.

"9. The combination with a wheeled vehicle, of an electro-dynamic motor centered upon the driving axle thereof at one end, a spring support for that end of the motor from the truck or body of the vehicle, and relieving axle wholly or partly of dead weight, and a spring support for the support for the other end of motor from the truck or body of vehicle, substantially as set forth."

This patent was before the Circuit Court of Appeals for the Eighth Circuit in Adams Electric Railway Company vs. Lindell Railway Company, 77 Fed. Rep. 432, which was brought upon patent No. 300,827, dated June 24, 1884, and granted to A. Wellington Adams for improvements in electric motors, against structures made according to this patent as infringements. The position of Sprague's invention with reference to prior structures, inventions and patents is there well and comprehensively set forth by Judge Sanborn in the opinion of the court; and the decree dismissing the bill appears to have been affirmed because, in short, Sprague's invention was independent of Adams's. And if Sprague's patent was for merely hanging and centering one end of the motor of a carriage upon the axle of the driving-wheels, and suspending the other by a spring from the body of the vehicle, or the truck, it would be shown from that case to be wholly lacking in novelty and void. He was not a pioneer here, and could have a valid patent for only what was new in his method of making the power of the electrical current turn the driving-wheel. No one had before, however, hung a field magnet at one end upon the axle of the driving-wheels, and at the other upon a spring from the body of the car, or the truck, and an armature axle upon the pole-pieces of the magnet, parallel with and geared to the axle of the driving-wheels, for driving a car by a current of electricity. This combination simplified greatly the required structures, improved their results and came into immediate use. The invention of it seems to well support these claims of the patent.

The defendant's structures differ in some respects from those of the patent, but have all these parts working together in the same relation to each other, for the same purpose, and producing the same result. They are altered by the addition of a joint in the motor, and of another spring to help carry it, but not by dispensing with any of the parts: they are improved upon but not departed from. The defendant's improvements are not made independent of, and clear from, Sprague's, but upon his; and his patent appears to be infringed by this taking of his invention to improve upon.

Decree for plaintiff; HOYT H. WHEELER.

FREDERICK H. BETTS, for plaintiff.

CHARLES F. MITCHELL, HENRY B. BROWNELL, for defendants.

(Endorsed) United States Circuit Court, Southern District New York, Sprague Electric Railway and Motor Company vs. Union Railway Company. Opinion, WHEELER, J., United States Circuit Court, filed January 24, 1898. JOHN A. SHIELDS, clerk.

Death of Wm. Habirshaw.

Wm. Habirshaw, only son of Mr. W. M. Habirshaw, of the India Rubber and Gutta Percha Insulating Company, died of pneumonia at Yonkers, N. Y., on Sunday of this week. He was a young man of great promise, and had been an assistant to his father in the manufacture of Habirshaw wires and cables.

A Unique Storage Battery Offer.

Elsewhere in this issue of the ELECTRICAL REVIEW will be found a unique and generous offer made by Sipe & Sigler, of Cleveland, Ohio, for the purpose of introducing the Willard storage battery to a wider circle of acquaintances. The offer is worthy the attention of any one interested in accumulators.

The Flynn-Boland syndicate, of which Patrick H. Flynn, of Brooklyn, N. Y., and William A. Boland are leading members, has obtained control of the People's Traction Company and of the New York, Westchester & Connecticut Trolley Road. The syndicate proposes to develop the territory above the Harlem River to its fullest extent.

TELEPHONE MEN CELEBRATE.

THE TWENTIETH ANNIVERSARY OF THE OPENING OF THE FIRST TELEPHONE EXCHANGE THE OCCASION OF A BANQUET AT NEW HAVEN.

The Southern New England Telephone Company, Mr. Morris F. Tyler, president, gave a dinner to a number of well known telephone men at the New Haven House, New Haven, Ct., Friday evening, January 28. The occasion recognized the twentieth anniversary of the opening of the first telephone exchange in New Haven in 1878.

President Tyler welcomed the guests in an informal and interesting address, and Gen. E. P. Meany and Mr. Thos. D. Lockwood also spoke ably and entertainingly. Before the agreeable party broke up nearly all present were called on and gave brief accounts of early experiences in telephone work. Mr. Joel C. Clark contributed an original poem.

Among those present were the following-named gentlemen from the companies named:

President Morris F. Tyler and General Superintendent E. B. Baker and associates, of New Haven, Ct., Southern New England Telephone Company; Chas F. Cutler, New York, New York Telephone Company; Wm. D. Sargent, Brooklyn, N. Y., New York & New Jersey Telephone Company; Gen. E. P. Meany, New York, American Telephone and Telegraph Company; Thos. D. Lockwood, Boston, American Bell Telephone Company; A. C. White, Providence, Providence Telephone Company; D. I. Carson, New York, Southern Bell Telephone Company; Samuel Ivers, New Bedford, Southern Massachusetts Telephone Company; W. J. Denver, Boston, New England Telephone and Telegraph Company; H. L. Storke, Auburn, Empire State Telephone Company; W. N. Easterbrook, Elmira, New York & Pennsylvania Telephone Company; T. B. Doolittle, Boston, American Bell Telephone Company; Alexander Cameron, Brooklyn, New York & New Jersey Telephone Company; A. L. Salt, New York, Western Electric Company. Others present were James English, Gen. S. E. Merwin, A. H. Robertson, John W. Alling and Joel C. Clark.

Henry Electrical Society.

The 96th meeting of the Henry Electrical Society will be held at Columbia University, New York city, in the Engineering Building, Room 302, on Friday, February 4, 1898, at 8.15 P. M., when A. H. Ford, electrical engineer, will deliver an experimental lecture on "Transformers."

TOLD IN THE DYNAMO ROOM.

It was a little over a week since Bert had explained his wonderful current straightener to his fellow workmen. Mr. Evans had gone East to arrange for the purchase of a two-phase generator and was not expected home for several days. Bert had plugged in the last street circuit and was watching the regulator on the arc dynamo as the brushes were moving to their neutral position, when Benson remarked.

"You may not believe it, but I think that for the last week or so, that C machine does not take nearly so much power to pull it as formerly. I noticed the same thing once before when we had that long, cold spell of January weather. I wonder what is the cause of it?"

"Yes, I believe the brushes are fully half an inch higher on the commutator," replied Bert, "it must be due to the intense cold. You notice that C is farthest from the engine and right up to that north window."

"Now, Edison, don't you come with another one of your scientific explanations, like that about the sine curve business, or I'll make you think you struck a live wire!"

"Why, no, this is dead straight, and I can figure it out for you in five minutes. You know, of course, that the resistance of copper wire increases with heat. Now, I should think that the fields of that machine have enough wire on them to make a perceptible difference in the resistance between 130 degrees in the Summer and about 80 degrees in Winter. I wish I knew the resistance of that field and I'd soon convince you that I'm not so far off."

"Well, maybe you're right, Edison, maybe you're right, but I doubt it," retorted the engineer. "Suppose you figure it all out and then show us the results."

"All right, I'll do that to-morrow. I wonder what is keeping Jim this evening; he promised to be here by six o'clock and help me with a little problem I'm working on. I tell you, Benson, if my scheme works, and so far I have found no reason why it won't, we won't have to get that new alternator at all."

Just then Jim made his appearance, and, contrary to his usual custom, he was dressed in his best suit, had on a flaming red necktie with a miniature incandescent lamp pin, wore tan-colored gloves and was carrying a cane, that in size resembled a small telegraph pole.

"Well, by gosh! What's up now, Jim?" exclaimed Benson, almost dropping the oil can, while Bert in his astonishment gave the alternator rheostat such a twist that the company's patrons must have thought the engine had run away.

"Oh, nothing special," nonchalantly replied Jim, airily twisting the end of his mustache. "What's the matter with you ducks anyway? Can't a fellow dress up once in a while without everybody commenting about it? I've asked Dick Harlow, of the Postal company, to stay here for me to-night and he'll be here in a few minutes. As far as your h. s. is concerned (which means humble servant), he is going to make a call on a young lady, if anybody asks you, and she's up to voltage, too; ta-ta;" with which he stalked out of the station.

"Now I'm sure of it!" ejaculated Bert, as Jim walked out.

"Sure of what—that Jim has a short-circuit somewhere in his upper story?" asked Benson.

"Why, not at all; Jim's in love, that's all, and I believe it's that head waitress at the Metropolis, judging from the way Jim has been hanging around there of late, fixing cut-outs, putting in new fuse plugs, changing lamps, and goodness knows what not."

"'Oh, that's the way the land lies,' as Columbus said when he discovered America. Well, Jim is a good boy, and I hope he'll marry a good girl. I hear Meg barking in the boiler-room. Guess it's Dick Harlow. He ought to be in the electric business instead of climbing poles for the telegraph company. Come in, Dick, and make yourself at home."

"All right, boys, I will; how are you? I told Jim I'd stay for him this evening while he made a society call."

"Yes, Jim is getting a trifle *recherché* of late. You won't have much to do, however, as everything is working like clockwork. Maybe you can help Bert discover the reason why one of the arc machines pulls so much easier on a real cold day than on a hot one," after which Benson explained to Dick the conditions that puzzled both him and Bert. Dick hung up his overcoat, settled back in the carbon-box chair, and, having pulled a sawdust-filled box, which answered the purpose of a cuspidor, to a convenient position, he remarked:

"Well, now, that's evidently a curious case. Offhand, I should say that Bert is right, for his theory seems very plausible. It depends, of course, on the resistance of the fields, as you call them, and on the pressure of the machine. Copper, you know, increases in resistance .216 per cent for every degree in rise of temperature, and if there is a difference of something like 50 degrees between temperature extremes, it might make a change of over 10 per cent in the field resistance. I don't know if that would really be noticeable in a machine of that size."

"Of course it would," exclaimed Bert, who had been an interested listener. "But I'll get a bridge to-morrow and find out all about it. I'll just bet you a nickel that's where the trouble is."

"Hold on, Bert, not so fast; don't bet unless you have a sure thing. I found that in telegraphy things are not always what they seem, and I presume it's that way in your business, too."

"Yes, and a darned sight worse, sometimes," interrupted Benson.

"For instance," continued Dick, "several years ago I had a similar case on the M. K. & T. line, between Sedalia and Denison. The New Orleans quad ran along that road, and the way that wire would change its resistance would make you gray-headed. I was morally certain it wasn't on my division, and when I was told by the chief operator to find the trouble, of course I found it, but it took me all Summer. Of course it wasn't in the relays, nor in the batteries or switchboards, but simply in the line."

"I don't see how that was possible," ventured Bert.

"Why, it was so simple that it was the last thing I thought of, and it probably wouldn't have occurred to me at all if one day I hadn't been talking to the operator at Da, meanwhile tightening and loosening the binding post of one of the sounders. I noticed that as I loosened one of the nuts the sound would grow weaker, and in a flash it came to me that it must be a loose connection that caused all the trouble, and so it proved. I took a helper along and we went over about 80 miles of a certain division, taking up slack and cutting out more loose connections than I could keep count of. The fellow who was in charge of that division had never soldered a joint, and the joints he had made were so loose they almost rattled. So you see whenever it got cold enough the wire got tighter and most joints would make tolerably good contact, but on a hot Summer day there was trouble galore. I would advise Jim to go over his circuit first."

"I'd like to have you suggest that to Jim," smilingly remarked the engineer. "He thinks his lines are in the most perfect shape in the state."

"Maybe so," replied Dick Harlow; "from what I know of Jim he is rather apt to take things for granted."

"Just so; he reminds me very much of the 'electrician,' as he called himself, whom I met out in Peabody, Kas.," spoke Benson, cutting off a generous chunk from the plug of tobacco Dick had reached over to him. "I was there for a week erecting the engine that was to run the new arc-light plant and I got pretty well acquainted with this electrician, Hutchins, I think his name was. The arc plant was of the old Western type, using, I think, 18 amperes, and the circuits were all run of No. 5 copper wire. The Western company put in the plant complete, and, while their men were stringing the wires, Hutchins told me confidentially that in his opinion the company stood in with the wire people, because over in Nickerson the Brush company were putting in an outfit and they only used No. 8 wire. I told him that in all probability the Western company knew its business and for him not to worry. Well, about a month after that, I had to wait over in Peabody for a train to Wichita, and, having about an hour to spare, I hunted up Mr. Hutchins. Among other things he told me was that he had connected up two more arc lamps and was using No. 16 bare copper wire for his circuit; 'and Benson, my boy,' he triumphantly exclaimed, as I bade him good-bye, 'it works like a charm.'"

"Well, the blamed idiot!" disgustedly remarked Bert.

"Simply a case of a little knowledge being a dangerous thing," suggested Dick. "You didn't hear how many lamps that genius eventually connected on his No. 16 circuit, did you?"

"No, I didn't hear, but I'm sure he is not in the electric lighting business now," said Benson.

"Well, boys, it's getting pretty late, and I guess you can get along without me now," remarked Dick, getting ready to leave.

"Yes, we'll manage all O. K.," said the engineer; "and if you are not out on the road next Sunday, drop in during the evening. I think Bert will be ready to show us his latest invention by that time. He is going to revolutionize things by making one dynamo do the work of two."

"That's the scheme, Dick, and if you can keep the thing to yourself until I get the patents, why, you're welcome to see it work," added Bert.

"All right, boys, I'll be on hand. Good-night to you."

Bert looked at the clock, but, as it still lacked an hour of the nocturnal lunch time, he found his corn-cob pipe that he had vainly longed for all the evening sticking in one of the switchboard holes, and, filling it from the engineer's package of "Mechanics' Delight," he was soon blowing rings of smoke into the air, deeply engrossed in his latest current-saving desire.

American Competition in Europe.

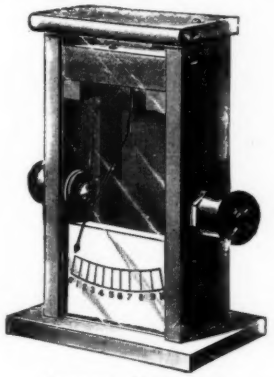
United States Consul Frank H. Mason writes from Frankfort, Germany, in part, as follows:

By far the most significant sign of the times is the rapidly increasing popularity and use in Germany of American machinery and tools. Here, as also to a large degree in England, American machine tools have become the mode among the more progressive class of machinists and manufacturers. The fashion extends at present more especially to shoemaking and tanning machinery, automatic lathes, planers and milling machines, and to the important line of special machinery used in bicycle manufacture. Not only by reason of the superiority of their machines, but on account of the energetic, intelligent way in which several American firms have gone about the work of introducing them into this country, they are entitled to special mention in this connection as examples of the advantage of undertaking a new task in the right way.

All this is, however, the normal, progressive course of business. It can not be expected that the maker of a superior machine tool will neglect or refuse to sell it abroad because the result of its use will be to restrict the export market for a finished product. The contest narrows down ultimately to one of comparative resources, economy in manufacture and skilled enterprise in selling; and in all these, except the last, our country has assuredly nothing to fear. With the most modern and effective machinery, the most efficient labor, ample capital, and an unequaled factory system, the Republic, in the closing years of the century, fixes new standards in cheapness of production, and passes definitely from the rôle of customer to that of competitor.

Cherry's Testing Instruments.

Two valuable but inexpensive testing instruments for both students and practical electricians are now being manufactured and sold by the Cherry Electric Works, 25 and 27 Third avenue, New York city, at a very low price. These instruments are a voltmeter reading from 0 to 10 volts, and an ammeter reading from 0 to 10 amperes. They are not toys because sold at a low price, but are scientifically constructed instruments. For amateurs and others experimenting with batteries, dynamos, motors, or using current for any purpose and to whom the standard instruments are too expensive, these will be found to be very valuable and trustworthy instruments. These instruments are



CHERRY'S VOLTMETER.

now constructed in hardwood cases, which give them a very handsome appearance.

Boston Edison Company and Its Employes.

The Massachusetts State Board of Arbitration and Conciliation gave a hearing last week on the application of the employés of the Edison Electric Illuminating Company of Boston for arbitration in the differences now existing between the company and its employés. The petition stated that the complainants would give the board three weeks to render a decision before the men would strike. The board took the matter under advisement.

Another City to Have the Underground Trolley.

The first underground trolley system to be installed in Brooklyn, N. Y., will probably be on the little road running on Montague street, from Court street to Wall Street Ferry. This is at present operated by cable, but the Brooklyn Heights company, in whose system it is included, contemplates an early change to the underground trolley. The change will cost, it is said, about $100,000.

EXPERIMENTS ON THE GLOW LAMP.*

BY HIRAM S. MAXIM.

It was, I think, about 18 months ago that a very clever American, whom I knew to be an important man in the electric light business in the states, came to me with what purported to be a new and economical lamp. It was claimed that this lamp would save about one-third of the current. I think about six months were consumed in experimenting after the first call, before the lamps were actually brought to me in quantities to test. I purchased a quantity of lamps direct from the best known makers, and put the new lamps in competition with these, with the result that the former proved themselves to be slightly better as regards duration, but the new lamps gave more light for the energy consumed, the difference being about as 3½ is to 4. The purchased lamps began to give out at 300 hours, and were not so long-lived as I had been led to believe. Wishing to know how much current was consumed per candle-power, I had various lamps tested. I also made inquiries at electric light stations. At Knightsbridge station I was informed that the average commercial lamps now in use required nearer six than five watts per candle-power, nothwithstanding that they claim four. I also found that there were some two and one-half-watt lamps for sale by various companies, but all of these were extremely short-lived. After testing the new lamps brought to me by the American, I decided that there was not enough in the invention to make it of any value, and commenced a series of experiments myself.

I think it was last June that I put up a number of new lamps made on a new plan. One of them, on testing, was found to be less than two watts per candle-power, and it was not thought advisable to put this up to be tested. However, I put it in my library. It was found to be 42 candle-power. At the end of about two months it had gone up to 54 candle-power. It is still running, and at the last testing was 46 candle-power. This is the lamp that was seen by the American newspaper reporter, and the one which has been so much discussed in the American press. While the light is still very strong, there is a slight discoloration observable in the glass, but it is of a transparent nature and does not seem to interfere to any appreciable extent with the light. I have made a great variety of lamps, and it appears that a considerable saving is obtained by the changes which I have made. I know I can save 25 per cent; my experiments appear to show that I can even save 33 per cent. The filament is manufactured and treated on a new plan, and a new form of combined mechanical and mercury pump quickly and cheaply produces a degree of vacuity which is, I think, considerably above that employed in the ordinary commercial lamps. So far I am quite able to make lamps of 2.5 watts per candle-power and below, which last a long time without any appreciable diminution of light. The usual tests are 1,000 hours, though some have been tested 1,200.

The greater part of the filament is carbon, but the resistance and tenacity is increased by the addition of a compound consisting of several substances. I have experimented with many substances. I know it has been said by those high in authority that no substance can be mixed with the filament of an incandescent lamp that can not be volatilized out of it. Later on I shall be pleased to submit some lamps and let the parties attempt to drive out the non-conducting material that they contain. I do not think they will succeed. The new lamp promises so well that I have taken a small shop, and am now getting ready to make a quantity of the lamps. With new and improved apparatus I shall be able to make all my lamps as good as the best of them are now made. What has been done can be done again, and I see no reason why we should not put into the market a lamp which in light-giving power and lifetime will be considerably better than the best lamps now in the market. As far as patents are concerned, I presume it will take about half a dozen to cover the filament and the system and appliances for making it and preparing the lamp for the market. No patents are completed yet; they are only applied for. A great number of materials experimented with were found to be absolutely useless. I presume we shall be selling lamps inside of six months—perhaps sooner. I would say that one of the new features of the lamp is that the filaments, before being mounted in a lamp are subjected to a much higher temperature than has been heretofore possible. This, of course, has a tendency to prevent any change taking place in the filament after it has been mounted in the lamp. It will also be understood that it only requires a very slight augmentation in the temperature in order very greatly to increase the light-giving power of lamps.

*From London *Lightning*.

CHICAGO NEWS NOTES.

We must congratulate our juvenile contemporary, *The Telephone*, on the new title page with which it enters its second volume. The change is a good one.

From the activity in the literary department of the Western Electric Company, in the way of preparing cuts and illustrations, the new edition of the company's catalogue, soon to be issued, will surpass anything of its kind.

Mr. H. R. King, general manager of Cloos Electrical Engineering Company, Milwaukee, ran down to Chicago for a day or two last week on business connected with the Cloos high-potential safety devices, which will be placed on the market at an early day.

According to a newspaper report a vein of free electricity has been discovered in St. Louis, and anybody can have all the current desired if he would make the proper connections with the street railway tracks. In other words, the bonding of the tracks is said to be so poor, and such inadequate return wires are provided, that favorably located gas and water mains form a better connection than the rails. Several owners of barber shops and occupants of basements have availed themselves of this condition of affairs to run small motors or to burn lights. A thing like this would be impossible in Chicago, and local electricians are expressing surprise that it is allowed to exist in the Missouri town. C. E. K.

Chicago, January 29.

LATE NEWS.

The American Loan and Trust Company, of New York, on January 29 procured from Justice Dunwell an order directing the sale of the franchise and property of the Geneva, N. Y., Brush Electric Light and Power Company. Continued and united opposition of gas magnates and kerosene oil dealers is said to have worked the destruction of the corporation. Although a city, Geneva will hereafter be lighted by kerosene.

A check for $1,000,000 was presented last Saturday at the office of the New Jersey Title Guarantee and Trust Company and was promptly certified by J. E. Hulshizer, Jr., the cashier. The check was drawn by Bernard M. Shanley, of Newark, N. J., against his personal account, and the money was to pay for the Newark & South Orange trolley road, which was purchased recently by Mr. Shanley, and is to be made a part of the Consolidated Traction Company's system.

PERSONAL.

Mr. T. C. Penington, of Chicago, secretary of the American Street Railway Association, was in New York city last week.

Mr. Frank A. Rogers has resigned the general management of the Card Electric Company, of Mansfield, Ohio, after two years' service.

Mr. J. Frank Morrison, the well known electric light magnate of Baltimore, came up to New York city for a few days last week.

Mr. Frank Hillis, of the well known electrical firm of Bagnall & Hillis, Yokohama, Japan, was among last week's visitors to New York city.

Among the prominent manufacturers who attended the meeting of the National Association of Manufacturers in New York city was Mr. C. M. Wilkins, of Partrick, Carter & Wilkins, the well known Philadelphia electrical firm.

Mr. Cyrus Robinson, formerly with the Ridgway Dynamo and Engine Company, has accepted the position of vice-president and engineer of the Hammond Manufacturing Company, of Portland, Ore. It is the intention of this company to add a branch to its present business, covering electrical equipments for mines, a line of work with which Mr. Robinson is particularly familiar.

Mr. Gustav Bissing, for many years principal examiner in Electrical Division A of the United States Patent Office, has tendered his resignation to take effect on January 31, 1898. Mr. Bissing will form a partnership with Mr. Joseph Lyons, a well known electrical expert and solicitor, for the practice of patent law in all its branches. The new firm will have its offices in the McGill Building, 908 G street, N. W., Washington, D. C. The ELECTRICAL REVIEW hopes that Mr. Bissing will enjoy full success in his new undertaking.

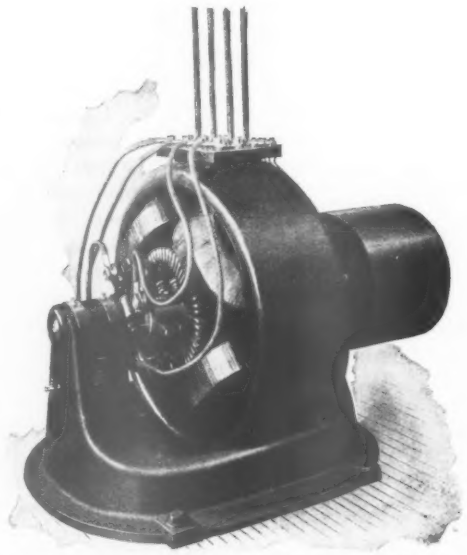


FIG. 1.—RUSHMORE'S MULTI-VOLTAGE DYNAMO.

FIG. 2.—RUSHMORE'S BAR-WOUND ARMATURE.

American Institute of Electrical Engineers.

The 121st meeting of the institute, which was held at 12 West Thirty-first street, New York, on January 26, was devoted to a discussion of the question of standardizing generators, motors and transformers. The discussion was opened by Mr. E. W. Rice, Jr., and was participated in by Messrs. Lozier, Kennelly, Wolcott, Hutchinson, Mosscrop, Lieb, Dunn, Coho, Pattison, Henshaw, Steinmetz, Mailloux and Osterberg. The appointment of a committee to consider the question was suggested, and subsequently the whole matter was referred to the council for such action as it may deem proper. At the meeting of the council in the afternoon thirteen associate members were elected.

The Rushmore Multi-Voltage System.

The only serious objection to the employment of large, slow-speed, direct-current generators has been the lack of flexibility in distribution for such machines. As heretofore employed they will give their output at but a single voltage, and where variable pressures are required it has been necessary to employ boosters and rheostats. Few engineers have believed that a machine could be built to meet the requirements of service and compete with the standard single voltage machines in first cost and efficiency of operation.

Some years ago Mr. S. W. Rushmore, of the Rushmore Dynamo Works, Jersey City, N. J., turned his attention to the subject and after much study and experimenting he discovered that, by properly distributing the current in the armature and controlling the excitation of the different poles, an ordinary multipolar generator could be made to deliver its output at as many different and independently variable voltages as there are pairs of field poles, so that each pair of poles with the adjacent section of the armature and pair of brushes constitute, as it were, a separate generator with the voltage from each pair of brushes independently variable from zero to maximum without the least mutual interference.

Fig. 1 shows a four-pole two-circuit machine now on exhibition at the Rushmore Works, and Fig. 2 is the bar-wound armature employed. This machine is shown in connection with a special switchboard for showing all its various applications. When brushes of the same sign are connected together on a single circuit, the machine will deliver its entire output in the usual way. One pair of brushes is shown connected to a water rheostat taking 125 amperes at 110 volts, while the other pair is connected to the same water rheostat through two smaller rheostats corresponding to the resistance of a pair of feeders to the circuit supplied by the first pair. The voltage may be raised on the second pair of brushes to as high as 150 volts to deliver another 125 amperes to the main rheostat, thus meeting all the conditions of a feeder and main system with a loss of 40 volts in the feeder. This arrangement is shown in Fig. 3.

The machine is also shown carrying one-half of full load on one pair of brushes at 110 volts, while the other pair is connected directly to the brushes of a separately excited ele-

vator motor, and the motor is started and stopped and run at any speed in either direction under full load by simply varying the electromotive force supplied to it by the dynamo, and, although this variation is all the way from 0 to 150 volts in less than two seconds, there is no interference with the lights on the other brushes.

In connection with storage batteries, the machine may run in parallel with the cells at full load, and at light load one or more pairs of brushes may carry the load, as shown in Fig. 4, while the other pair is connected to the battery and the voltage raised to any amount for charging, thus dispensing with resistances.

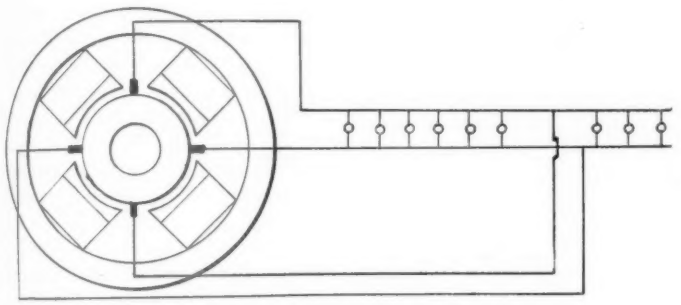


FIG. 3.—RUSHMORE'S FEEDER AND MAIN SYSTEM.

When the battery is employed to steady a fluctuating load, the cells are connected to one or more pairs of brushes, as shown in Fig. 5, and by means of series coils on the poles acting on the sections feeding the battery, the battery will automatically charge and discharge to keep the load on the engine constant.

The machine is shown operating as a motor-dynamo, taking current at one pair of brushes and running at constant speed and delivering current from the other pair, the voltage on the second or dynamo pair being varied from 0 to maximum by a rheostat in the corresponding field circuit, thus, it is claimed, having all the advantages of a motor-driven dynamo with better efficiency and without the extra cost of two machines.

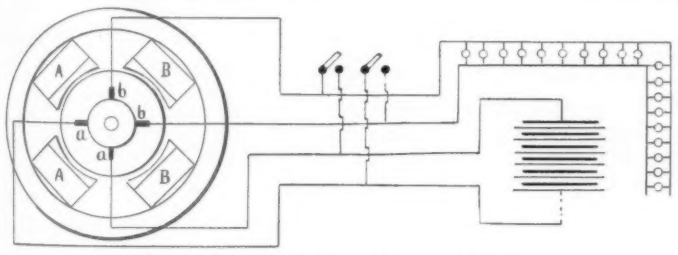


FIG. 4.—RUSHMORE'S PLAIN BATTERY SYSTEM.

In all the experiments the brushes are fixed and there is said to be no sparking, even though the current at times exceeds 50 per cent overload over the whole range of voltage.

The principle on which the machine operates is in some respects similar to that of the Rushmore multi-circuit arc dynamo, described in the ELECTRICAL REVIEW,* which consists in collecting current from the armature in such a manner that the armature flux does not affect the strength of the poles under which the current is directly collected. This is shown in Fig. 6, which illustrates the distribution of the armature flux in a four-pole machine, with ring armature, with current taken from only one pair of brushes, the field flux being omitted. In the diagram it is assumed that the total armature flux consists of but four lines; two of the lines will circulate across the face of S', under which the current is directly collected, while the other two lines will pass through N' in a direction to oppose the field excitation, then around the field ring and through N'' in a direction to assist in its magnetization, thus completing their circuit.

In this manner the effect of current in the armature, through the brushes A and B, is to weaken the pole N' and, to a like extent, strengthen pole N'', while pole S' is affected only by the cross magnetization, and pole S'', under which current is collected for another circuit, is unaffected.

When the loads on both pairs of brushes are equal, the distorting influence due to one current is equal to and neutralizes that due to the other, and there is then no interference, and the machine acts exactly the same as if operated in the usual way on a single circuit. Various methods of winding additional series, as well as shunt-opposing and compounding coils, on the affected poles to neutralize the effects of armature flux have been tried by Mr. Rushmore, but as there is no interference whatever with the proper working of the machine when currents are collected directly under only the unaffected poles, such devices have been discarded as unnecessary in commercial work.

With a lap-wound drum-armature the distribution of the armature flux is more complex, as the current collected from a single pair of brushes passes under both poles of each pair. All the poles of a four-pole machine are thus affected, but as the current from each pair of brushes strenthens one of its poles as much as it weakens the other, there is no interference. Thus the only requirement for adapting common drum-type machines to this system is that the armature must be of a multi-circuit or lap-wound type now generally used in all large machines.

Different pairs of brushes may be connected in parallel to meet the requirements of the different circuits, but before thus connecting, the different pairs must be brought to the same potential.

*ELECTRICAL REVIEW, July 21, 1897, page 29; August 1, 1897, page 55; September 8, 1897, page 115.

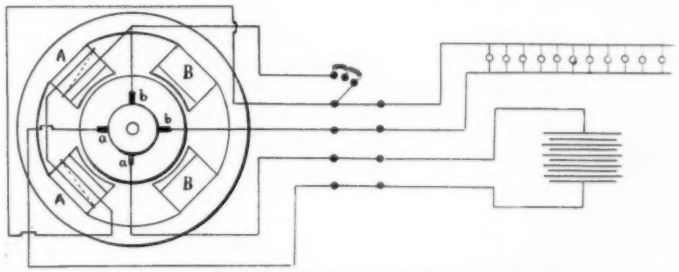


FIG. 5.—RUSHMORE'S DIFFERENTIAL BATTERY SYSTEM.

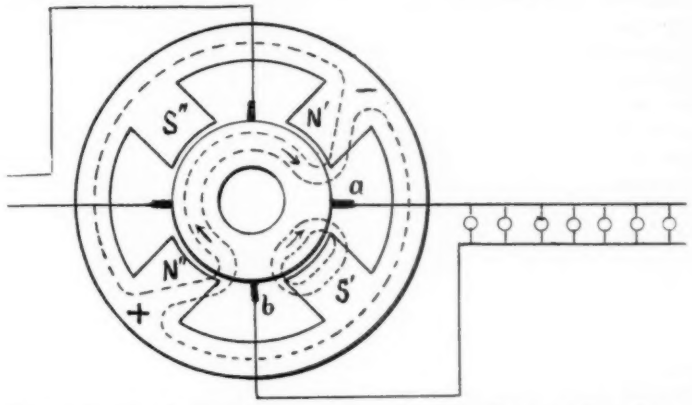


FIG. 6.—DIAGRAM SHOWING DISTRIBUTION OF ARMATURE FLUX IN A FOUR-POLE RUSHMORE DYNAMO.

The Edison, Jr., Incandescent Lamp.

As a means of more fully demonstrating the rigidity of the filament that Thomas A. Edison, Jr., has attained in his new "Edison, Jr." lamp, several tests have lately been made by him with lamps of low voltage connected with a circuit of double the amount of volts. Taking a 52-volt incandescent lamp, he connected it with a wire carrying 115 volts.

The lamp burned for six minutes and 40 seconds in one test, and in another for 20 minutes, giving out an intense light almost brighter than that of an arc lamp.

During the life of the lamp an average of 1,400 candle-power was shown on a 16-candle lamp. It is evident from the experiments made by Mr. Edison that he has attained a high state of perfection in his filament. He is prosecuting his work in this line and hopes for additional important results.

New York Police Telegraph Bureau.

The new police telegraph bureau of New York city was instituted last week by the selection of Michael R. Brennan as superintendent and Edward H. Murphy as his assistant. Frank C. Mason was made assistant superintendent in charge of the borough of Brooklyn. The board instructed the superintendent to prepare plans for the extension of the telegraph system throughout the boroughs.

Electrical Books — Practical and Elementary.*

"Oh, that mine enemy would write a book!" is a wish that might not inaptly proceed from the thoughts of many a practical electrical engineer to-day, for, undoubtedly, were the said enemy to do so, it may be taken for granted that the work would be constructed upon the same lines that have now apparently become stereotyped, and thus would arise the opportunity for attack. Perchance from out of the resulting conflict might arise some truths that would impress themselves upon those who seek to impart their knowledge of electrical engineering to their less learned brethren. That the writers responsible for many existing treatises have not been assailed more often is possibly due to the imposing effect of the professional character and reputation that surround them, or it may be that they are fortunate enough to exist without enemies.

Nevertheless, it is a fact that a current of opinion is commencing to flow, which will, sooner or later—and the sooner the better—sweep away not a few prevailing opinions as to the proper manner of compiling the works required by the electrical engineer for the furtherance of his knowledge.

Almost the first impression that one receives after studying a few of these books, both those recognized as standards and others of less note, is that each individual author seems to arrogate to himself the honor of being the reader's sole teacher of all the elementary facts regarding electricity. In the case of a work that is not only professedly, but actually, introductory to the study of a subject, no objection of this nature can reasonably be made. The majority, however, while claiming on their title pages or in the prefaces to be elementary, have, as a matter of fact, ceased to be so, long before the concluding chapter is reached. In a very limited sense they may indeed be termed "elementary," but for all practical purposes this description is misleading and affords no complete and real intimation of the nature of the contents. A work that, for instance, discusses, amongst other things, the design of 500 kilowatt dynamos, the effects of self-induction in alternators or combinations of resistance, self-induction and capacity of transformer circuits, can not fairly be regarded as elementary, even though it also deals in its early part with the units of measurement or the method of calculating horse-power. While it is true that instruction in first principles is necessary in order that a grasp of any branch of electrical science may be obtained, it does not follow that the beginner should be dragged through the whole range of electrical engineering in one volume; and, conversely, the man who has passed the initial stages should not be expected to go over again and again work with which he already is conversant. Some day it will dawn upon a writer that the average engineer who seeks to enlarge his knowledge has gone through the electrical alphabet, and no more requires to repeat his letters than he does to learn his own name. Then all those points of information which at present seem to be included in the majority of works—the statements regarding the supposed natures of electricity, the description of simple experiments from the rubbing of amber, or sealing wax, to that hoary-headed and inevitable old friend, the demonstration of the lines of magnetic force by means of iron filings on a card—these and the multitude of others will become incorporated into true elementary works alone. Everything has its place, and there is just cause for complaint at the inclusion of these facts in works that subsequently attain to heights quite above the reach, for some time to come, of the learner who is a learner from the beginning.

The practice is to be regretted for more reasons than one. Even in the case of those who have justly earned the right to be regarded as the authors of standard works, it would undeniably be of benefit to their writings if a division into different volumes of elementary, middle, and advanced stages were made. Thus each course would receive more ample and explicit treatment than is now practicable, owing to the necessity of paying due regard to considerations of space.

To the electrical engineer a technical library of his own is an absolute necessity; more often than not it is formed slowly, for generally the princely remunerations that are the rule in this, the richest country in the world, become in most cases attenuated almost to the vanishing point when the ordinary cost of living has been met, and consequently books can only be indulged in at infrequent intervals. When the majority of works that in their main part are really helpful to the practical man, each contains from one to five, or more, chapters devoted to the simple elementary principles of electricity before proceeding to instruct in modern methods and applications (the matter that sells the book), an injustice is done to the purchaser, who has to take what he does not want, in order to obtain that which he does. It may, perhaps, be contended that one or two standard works on any theme contain practically all that the average man requires to know, therefore no real ground for objection to the inclusion of the introductory course exists, seeing that these are sufficient in themselves for instruction in the subject they deal with.

Admitting, for the sake of argument, that it is not necessary to possess more than this number, there still remains the fact that knowledge should be imparted in accordance with the needs of the learner. To assume a man's complete ignorance of everything connected with electricity because he asks for information on dynamo design or polyphase power transmission practice is nothing less than to offer him an insult. A writer on the derivation of language does not commence a treatise by instructing his readers how to spell, neither does the political economist consider it necessary to first explain to his disciples the meaning of such words as "land," "king" or "people." And yet this is precisely the kind of error that so many writers of electrical books commit to-day. With the class of works compiled expressly for the use of the students of A, Technical College; or B, Engineering Institution, these remarks are not now dealing. Such form a class to themselves, and exist for a specified purpose that is distinct from the one under discussion. But in the case of those put forward for the use of the practical electrical engineer—the man who is engaged in handling, operating or manufacturing apparatus and plant—it is time that attention should be paid to actual requirements.

The present mode of treatment would appear to be a survival of that past day when the various branches of electrical science were more or less in an embryo state—when, in fact, electricity was "in its infancy"—and could be adequately dealt with between the covers of one volume. The advance of knowledge has already brought us specialized works; it yet remains to separate in these the elementary portions from the more advanced. With the accomplishment of this "consummation devoutly to be wished" will come a satisfaction to the young beginner, to the practical man, and last, but not least, to the author.

*From the *Electrical Review*, London.

Electrolysis of Buried Metals.

To the Editor of Electrical Review:

Perhaps no other person has had the opportunity to study the question of electrolysis upon buried metals in so many parts of the country which has been my privilege; for this reason a word of opinion may not appear out of place.

While I recognize the fact that many statements are overcolored, I am strongly impressed with the fact that municipalities and private companies, suffering from this new trouble, do not, as a rule, sufficiently realize the fact. They allow the process of electrolytic decay to go on until the damage is so severe that expensive repairs have to be made.

As a large proportion of the electrical engineers are interested in power transmission, and as electrical papers are also interested in such matters, I am not sure that both the engineer and the electrical journal do not underestimate the damage which is quietly, but none the less surely, progressing from this cause. My reference to the Brooklyn Bridge in the paper read before the American Institute of Electrical Engineers, in 1894, was of the briefest character, and yet should have been sufficient to attract the attention of those who were interested in that structure and its preservation.

If the anchorages are absolutely dry I can see no reason why danger should exist there, even with currents now found upon the Bridge. On the other hand, if the anchorages are damp, and particularly upon the New York side, then unquestionably electrolytic corrosion is going on at this point. No one can deny the serious nature of corrosion at the anchorages or the importance of applying a remedy.

It may be difficult to determine whether or not there is moisture about the anchorages; but, fortunately, it is not absolutely necessary to determine this, since proper provision for drawing the electric currents out of the Bridge would be comparatively inexpensive and would overcome the danger.

Sincerely yours,
I. H. Farnham,
Electrical Engineer.
Boston, January 18, 1898.

The Delaware, Ohio, Street Railway has gone into the hands of a receiver.

Death from 230 Volts Alternating Current.*

Four cases of death from electric shock, occurring in a single factory, in which the fatal pressure could not

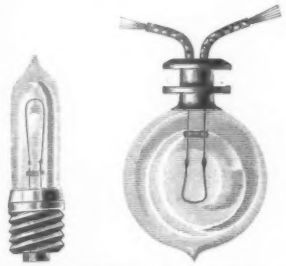


FIG. 1.—TELEPHONE LAMP. FIG. 2.—THEATRICAL LAMP.

have exceeded 230 volts alternating, are reported in the *Elecktrotechnische Zeitschrift* of December 30. The name and nature of the works—except that it is a chemical factory—are purposely withheld by our contemporary, but from the facts mentioned it appears that the place, by the nature of the processes conducted there, was very damp, so that an excellent contact between the body and earth would be nothing exceptional. It is stated that the installation, which is on a 230-volt three-phase system, mesh-connected, had been put up in a thoroughly workmanlike manner, that tests had shown the insulation resist-

FIG. 3.—BATTERY LAMP, EXACT SIZE.

ance to be high, and that at all events in three out of the four cases the pressure to which the victim was subjected did not exceed 115 volts. It seems reasonable to suppose, however, from the dampness mentioned, and from what we know of German methods of wiring, that in each case the man must have experienced the full difference of potential of 230 volts, for it is hard to believe that three, or perhaps four, fatal shocks at 115 volts occurred from the same wires within a period of 16 months. That 230-volt shocks were fatal in so many instances is strange enough, especially when it is remembered after what careful consideration our Board of Trade fixed the low-pressure limit for alternating current at 250 volts.

In the first instance the unfortunate man was standing on the ground bare-footed, and turning the winch to wind an arc lamp to the top of its post. A terminal of the lamp came in contact with the pulley at the top of the post, and the workman received a fatal shock. In the second case the victim leant out of a window and purposely caught hold of a wire outside; in the third case, a wire had become unscrewed, and its end came in contact with the unearthed pipe which contained it, the shock being received from the pipe; and, in the fourth case, contact appears to have been made with a faulty flexible conductor or lamp-fitting. Where deaths have occurred from low-pressure shocks it has usually been considered that they were due not to an exceptionally good contact alone, but that the weak state of the health of the individuals contributed considerably to the effect of the shock. We have here, however, actual experimental data, from which, with a few details as to the precise nature of the works, it should be an easy matter to decide if the processes carried on in the factory in question are such as to induce a state of health particularly susceptible to a stoppage of the heart's action through shocks, or if the phenomena are to be ascribed merely to exceptionally good contacts. In either case the moral appears to be: Use earthed concentric water-tight systems of wiring and extremely low pressures in chemical works.

* From *The Electrician*, London.

The Smith Trolley Line, of North Tonawanda, N. Y., has been sold to Henry P. Smith for $50,000. The company will be reorganized and put on a good financial basis.

Miniature Incandescent Lamps.

The American Endoscopic Company, of Providence, R. I., are the manufacturers of a very extensive and complete line of decorative and miniature incandescent lamps. Their products include surgical, dental, series, special series, and candelabra lamps, as well as X-ray tubes and electrically lighted surgical instruments. In the accompanying illustrations are shown several types of lamps made by this company.

In Fig. 1 is illustrated a telephone lamp used for giving signals on telephone switchboards. These lamps are carefully made and have a long life. They take from 10 to 20 volts and from .1 to .14 amperes, giving from .2 to .5 candle-power. Fig. 2 illustrates a theatrical lamp for battery or series lighting. The prime advantage of this type of lamp is that

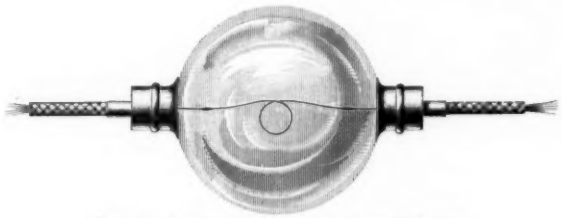


FIG. 4.—SPECIAL SOCKETLESS SERIES LAMP.

it may be easily attached to any fabric simply by being inserted as a collar button. For battery circuits these lamps are made to take from six to eight volts, .75 of an ampere, giving one and two candle-power. For series lighting they take 14 volts, .33 of an ampere, and give off two candle-power. They may be used eight in series on 110 to 120 volts, and four in series on 50 to 60 volts. Fig. 3 illustrates the company's high-efficiency battery lamp, shown in the cut in its actual size. It is a one-watt lamp, uses from 6 to 18 volts, from one ampere to .6 of an ampere, and gives from 6 to 10 candle-power.

In Fig. 4 is shown a special series lamp, which requires no socket nor receptacle. The illustration shows the lamp in full size. It was originally designed for window decorations, Christmas trees, theatrical effects, or for any purpose where festooning would show to advantage. This type of lamp is easily handled, by simply connecting the wire terminals from one lamp to the other. They are said to be absolutely safe from short circuit, and may be used eight or nine in series on 110 to 120-volt circuits. Each lamp requires, on an average, about one ampere of current. A series or multiple candelabra lamp of 12 candle-power is shown in Fig. 5 in its actual size. This lamp requires about .65 of an ampere. Fig. 6 shows an eight-candle-power candelabra flame lamp, using about .5 ampere of current.

FIG. 5.—CANDELABRA LAMP, EXACT SIZE.

Lehigh Valley Construction Company Assigns.

The Lehigh Valley Construction Company, of South Bethlehem, Pa., filed in the St. Lawrence County, N. Y., Clerk's office, on January 17, a deed of general assignment. Julius F. Workum, of New York, is named as assignee. The company had a sub-

FIG. 6.—CANDELABRA FLAME LAMP.

contract from the St. Lawrence Construction Company to do the work on the Massena, N. Y., canal for the St. Lawrence Power Company. The Lehigh Valley Construction Company has filed a mechanics' lien against the power company for $53,000, claiming to have done $78,000 worth of work in the last Summer, for which they had received $25,000.

ADVANCE INFORMATION

New Telephone and Telegraph Companies.

BOWLING GREEN, KY.—The Park City Telephone Company is the name of a new company that is being organized here and will at once commence the construction of new lines.

LEXINGTON, VA.—The Lexington Telephone Company has been incorporated, with W. S. Hopkins, president; N. C. Watts, secretary and treasurer, to manufacture apparatus and build telephone lines, but the principal power granted is the operation of the exchange here and building lines in Rockbridge County and elsewhere in Virginia; capital stock, $5,000.

MARION, N. C.—A telephone system is to be established.

RANDLEMAN, N. C.—J. R. Betts and others will establish a telephone system.

ROCKLAND, ME.—The cable telephone and telegraph line between Rockland and Vinalhaven has been completed.

MINNEAPOLIS, MINN.—The Southern Minnesota Telephone Company has been incorporated, with a capital stock of $30,000. The object of the corporation is to establish a system of telephone lines throughout Murray, Cottonwood and Pipestone counties, and, if desirable, to extend the line to other parts of Southern Minnesota. Incorporators: Chas. Webster, F. T. Follows, Thos. A. Way and T. A. Potter.

WARTRACE, TENN.—A telephone system is to be established.

LEWISBURG, TENN.—A new telephone line is to be constructed from Lewisburg to Thick.

SOUTH PITTSBURG, TENN.—The East Tennessee Telephone Company has just completed an exchange at South Pittsburg.

BEAUMONT, TEX.—The Southwestern Telephone and Telegraph Company has been granted a franchise, and will establish a telephone system and exchange.

NEW ORLEANS, LA.—The People's Telephone Company will construct and operate a telephone system, the wires of which are to be laid under ground in conduits.

TOCCOA, GA.—The Toccoa Telephone Company has been incorporated by John McJunkin, C. H. Dance, L. P. Cook and others for constructing and operating telephone systems; capital stock, $5,000.

Electric Light and Power.

PHILADELPHIA, PA.—The Philadelphia Electric Light, Heat and Power Company has been incorporated. The incorporators are G. R. Green, J. R. Embery, H. R. Baramore, J. J. McCarthy and Henry Watts.

SHEFFIELD, ALA.—The Muscle Shoals Power Company has been organized, with T. L. Carter, president; C. B. Ashe, vice-president; J. R. Coleman, secretary and treasurer.

CULLMAN, ALA.—James E. Clarke is interested in the construction of an electric plant.

COLVILLE, WASH.—The Colville Electric Light and Water Company has been incorporated with a capital stock of $60,000. The incorporators are Julius Pohle, Henry Oakes, W. B. Aris and S. Douglas.

ATLANTA, GA.—The Atlanta Water Power Company applied for charter, with Henry B. Wilson, Emerson McMillan, R. H. Smith and C. Emerson, to manufacture electricity, etc. The company has options on land valued at $175,000, including three shoals, which will develop 11,000 horse-power.

ORLANDO, FLA.—B. C. Abernathy and others will probably construct an electric light plant.

ELKIN, N. C.—The Elkin Electric Light and Power Company has been incorporated by Alex. M. Smith, Gilvin T. Roth and Hugh G. Cheatham, for erecting and operating an electric light and power system; capital stock, $2,000.

HARRISBURG, PA.—Mr. E. Mather, of this city, has been awarded the contract for the electric light plant to be erected at Marysville.

GLENS FALLS, N. Y.—The Consolidated Electric Company, with a capital stock of $10,000, has filed articles of incorporation. The directors are E. L. Ashley, E. J. West and Mrs. Elizabeth H. Ashley. The purpose is to furnish electricity for lighting and power in Fort Ann.

LAUREL, DEL.—The question of establishing an electric light plant at this place is being agitated.

New Incorporations.

BIRMINGHAM, ALA.—Articles of incorporation have been filed by the United Electric Company; capital, $4,200. The incorporators are M. T. Stradford, H. B. Gray and F. E. Nabors.

BALTIMORE, MD.—The American Signal Company has been incorporated, to manufacture automatic railroad signals and electric devices. Incorporators: Henry E. Wilkins, John W. Buck, Hiram M. Buck and Robert Biggs, of Baltimore; Thomas C. Murray, of New York city, and Richard O'Toole, of Frederick County, Md. The capital stock is $10,000.

BALTIMORE, MD.—The American Heat, Light and Power Company has been incorporated by Arthur F. Spice, Percy B. McLaran, Nicholas P. Bond, Edward P. Hill and Nathaniel Z. Seitz, to manufacture machines for producing heat, light and power; capital stock, $100,000.

CUMBERLAND, MD.—The Cumberland Improvement Company, capitalized at $20,000, has been incorporated. The incorporators are J. Henry Holzshu, David P. Miller, Arthur H. Amick, Simon Rosenbaum and Robert R. Henderson. The company is organized with a view to the development of Cumberland, including the building and operation of passenger railways.

ALEXANDRIA, VA.—A charter has been granted to the Standard Cold Electric Light Company, the purposes of which are the construction and manufacture of electric lamps for dental and surgical use. The principal office is in Alexandria and the capital stock is $100,000. Mr. John Boyd, of Washington, president.

New Electric Railways.

GRAND RAPIDS, MICH.—An electric railroad is to be constructed.

PADUCAH, KY.—A scheme is on foot to build an electric line from this place to Bandana, in Ballard County.

WASHINGTON, D. C.—The Capital Traction Company has obtained permission to make several extensions to its electric line in the city.

BALTIMORE, MD.—The Consolidated Railroad Company has decided to construct several extensions of its electric lines on Schroeder street and in the southwestern suburbs.

TIPTON, IND.—Business men of this place have organized a company to construct and operate an electric railway from Tipton to Atlanta, south, and to Windfall, north. The road will be ready to operate by March 20.

CUMBERLAND, MD.—A. Flick, of Altoona, Pa., and John M. Burchinal, of Moundsville, W. Va., are securing the right of way for an electric line from Cumberland, through the Maryland coal region, to Piedmont, W. Va.

MCKEESPORT, PA.—McKeesport & Irwin Street Railway Company has been incorporated to operate a line from this place to Irwin; capital, $120,000.

STANTON, MICH.—An electric railway is to be constructed from Grand Rapids to Belding, Stanton, Crystal, Ithaca and Saginaw.

Increase of Capital.

PEORIA, ILL.—The Peoria & Pekin Traction Company has increased its capital stock from $300,000 to $500,000.

Chicago Electrical Association.

The addresses included in the Spring programme for 1898 of the Chicago Electrical Association are as follows:

February 4, "Electricity in Ship Building," C. C. Mattison; February 18, "Electricity in Medicine," E. W. Jewell; March 4, "Relationship of the Hunter and Tesla Patents," A. Miller Belfield; March 18, "The Autobiography of a Piece of Wire," C. T. Gage; April 1, special paper by prominent engineer, to be announced; April 15, "The Electric Railway," W. R. Garton; May 6, "The Inclosed Arc Lamp," J. M. Hollister; May 20, annual banquet.

The meetings are held at 1737 Monadnock Building, and the secretary is J. R. Cravath, 825 Monadnock Building.

Bernstein Electric Company.

The Bernstein Electric Company, of Boston, on the 20th inst. made an assignment to Gen. B. F. Peach, Jr., of Boston, as announced in the ELECTRICAL REVIEW last week. It is the assignee's intention to continue the business and fill orders as promptly as possible.

The property and affairs of the Fox River, Wis., Electric Street Railway have gone into the hands of receivers. The road was built in 1894 and cost $265,000. The line runs to DePere, and also leases the Fort Howard line.

Kindred.... ...Interests

The Montauk Multiphase Cable Company, of 100 Broadway, New York, report a large number of inquiries regarding their new cable, and that it is attracting considerable attention among the electrical engineers throughout the world.

De Veau & Company, the well known manufacturers of telephones and telephone supplies, have removed their office and factory to 27 Rose street, New York city, where they will have more commodious and larger quarters. Their telephone number is 5332 Cortlandt.

The Newton Machine Tool Works, Twenty-fourth and Vine streets, Philadelphia, are the manufacturers of the cold saw cutting-off machine illustrated in the ELECTRICAL REVIEW for January 19. This firm are progressive manufacturers of machine tools, and early realized the advantages of direct-connected electric motors for certain of their machines.

The agency for the "Eureka" anti-friction metal has recently been taken by Fenton & Company, 39–41 Cortlandt street, New York. This metal has been put to the most severe tests for its use in high-speed and heavy engines, dynamos and all mechanical bearings, and has been highly commended by many of the leading experts in the country in comparison with all other metals of a like nature.

The Electric Fan Season Opens.

The Western Electric Company's 12-inch desk fan for 1898 requires less current to operate it than is used by a 16-candle-power incandescent lamp. This economy over fan motors of the past three or four years shows a great improvement in mechanical detail as well as electrical design. The Western Electric Company will soon issue a 32-page fan-motor catalogue, listing direct and alternating-current fan motors, also battery fan motors, and those interested in fan motors should write for a copy of this catalogue at once.

WANTED—A Business Man, who is also a Mechanical and Electrical Engineer, will be open to a position after February 1, as Manager of an Electric Lighting Plant or a Railway in any city of 30,000 or more. In present position has increased business ninety per cent in past year.

Address W. N. GRAY,
200 Neave Building,
Cincinnati, O.

LYONS & BISSING.

MR. JOSEPH LYONS, Electrical Expert and Solicitor, and *MR. GUSTAV BISSING, late Principal Examiner of Electrical Division A, U. S. Patent Office*, announce the formation of a partnership for the general practice of PATENT LAW, with its offices at the McGill Building, WASHINGTON, D. C.

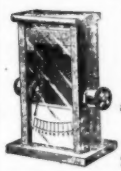
TO SELLING AGENTS.

A new company recently organized and at present engaged in equipping extensive and modern plant for the manufacturing of a large line of new and improved machinery for heavy steam plant work, desire to open correspondence with selling agencies, and dealers of experience in water-tube boilers, engines or electrical machinery, who are desirous of either adding to their present business or of making changes looking to more profitable connections. Everything offered by this company will be a distinct advance in efficiency and general merit over anything now on the market, and the new features by which such ends are attained will be entirely original. Fullest investigation solicited. Address, Box 438, Marion, Ohio.

TO CONTRACTORS—Sealed proposals for furnishing the materials and performing the labor required and necessary for the electric wiring and fixtures for Cottages Nos. 4, 5 and 6, of Group "D," at Central Islip, N. Y., and for furnishing the materials and performing the labor required and necessary for the consolidation of the electric lighting plants at the New Power House at Ward's Island, N. Y., for the Manhattan State Hospital, may be sent by mail or delivered in person up to 4:30 P.M., on the 3d day of February, 1898, to Henry E. Howland, Esq., President of the Board of Managers, No. 1 Madison avenue, New York city, at which time and place the Board will receive and open all proposals.

Drawings and specifications may be consulted and blank forms of proposals obtained at the office of the Board of Managers, No. 1 Madison avenue, New York city, and at the office of I. G. Perry, Architect, in the Capitol at Albany, N. Y. Separate proposals under each specification must be made and each bid must be enclosed in a separate envelope, and indorsed, respectively, "Proposal for electric wiring and fixtures for Cottages 4, 5 and 6, Group 'D,' Central Islip," and "Proposal for the consolidation of the Electric Lighting plants at Ward's Island."

GEORGE E. DODGE,
Secretary Board of Managers.



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Like cut, reading from 0 to 10, at $1.50 each. 0-25 at $5.00 each.

Cherry Electric Works,
25 & 27 3d Avenue, NEW YORK.

Telephone Users (INTENDING)

are reminded that the next quarterly issue of the TELEPHONE DIRECTORY will go to press on March 1st. To obtain the advantage of listing in this issue of the directory it will be necessary to make contracts during the present month.

NEW YORK TELEPHONE CO.
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18 Cortlandt, 15 Dey, 962 Broadway, 115 W. 38th.

Ten Years of Electric Railways.

On Wednesday, February 2d,

The Evening Post

will publish an able article

By GEO. H. GUY, ESQ.,

on the growth and development of Electric Street Car Systems. In view of the fact that just ten years ago the first electric car was run in Richmond, Va., this article will be found most interesting to all interested in electrical matters.

The Evening Post

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Electrical.... Patents.

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED JANUARY 25, 1898.

597,782 Telephonic installation; G. Ritter, Stuttgart, Germany.

597,785 Apparatus for telephone switchboards; C. E. Scribner, Chicago, Ill.

597,786 Telephone circuit; C. E. Scribner, Chicago, Ill.—In combination, a source of telephonic undulatory current and a receiving instrument therefor, in a closed conducting circuit, two windings of a repeating coil serially included in the circuit, a conductor including a condenser in shunt of the windings of the repeating coil, and a bridge uniting the points of junction of the windings of the repeating coil with the other side of the circuit.

597,787 Apparatus for telephone switchboards; C. E. Scribner, Chicago, Ill.

597,790 Electric cable; W. S. Smith, London, England—An electric cable of insulating material, formed with a central longitudinal air space and with two or more wires imbedded at distances apart in the insulating material near the inner circumference.

597,799 Electric railway; E. C. Crocker, Bridgeport, Ct.

597,816 Armature winding machine; C. Eickemeyer, Yonkers, N. Y.

597,848 Trolley; G. A. Hall, Portland, Me.—In a trolley, the combination with the curved roller stock, of the roller having an axle, the ends of which lie flush with the outer surface of the stock, spring plates secured to the stock to overlie the ends of the axle, and lugs with which notches in the end of the plate engage.

597,855 System of electrical distribution; H. Linton, Altoona, Pa.

597,860 Electric furnace; W. S. Horry, Sault Ste. Marie, Mich.

597,891 Electrically-actuated lock for bicycle racks; J. Erickson, Chicago, Ill.—In a lock of the class described, a combination of a locking mechanism, an alarm mechanism, a relay arranged to control the alarm mechanism, and a normally-closed electric arranged to control the relay.

597,917 Recording door lock; E. L. Smith, Torrington, Ct.

597,945 Electric furnace; C. E. Bradley, Avon, N. Y.

597,965 Coin-controlled machine; H. T. Emeis, Salt Lake City, Utah.

597,979 Electric switch; J. E. Hinds, Syracuse, N. Y.—In an electric switch, the combination of a base to which the switch terminals are secured, a blade for closing the circuit between the terminals, and a back or support consisting of a slotted tube to which the blade is removably secured.

597,981 Stamp-canceler and post-marker; S. R. Holmes, Frankfort, Ky.

597,985 Electric meter; G. Kapp, Berlin, Germany.

598,001 Electric switch; J. R. Newell, Titusville, Pa.—A pivot bar of insulating material, conducting plates at each end of the bar, spring plates at each end of the bar having outwardly-turned upper ends, a pin in the bar adopted to engage holes in the spring plates and means for spreading the plates and depressing the bar.

598,033 Electric signaling device; E. A. Stout, Jr., Philadelphia, Pa.

598,049, 598,063 Electric burglar alarm system; C. Coleman, Chicago, Ill.

Electrical Business Prospects in the West.

[*From the Western Electrician.*]

The manager of one of the great electrical companies, being asked to give his views on business, said:

"The business for the past year with us has been infinitely better in all respects than in the two years previous. We have sold more apparatus and have received promptly our pay therefor. Isolated electric light plants and local companies are being enlarged throughout the country. We hardly know of an electric light company that has not some plan, definitely or indefinitely formed, for rebuilding its station and increasing the amount of its apparatus and putting its properties in better condition. The above, of course, means a large amount of business for us and for others. Capital, however, is much more timid than it was in 1892, but if the 'powers that be' in Washington give the country a rest and do not agitate capital by tariff, financial and other useless legislation, capital will get over its scare, and a large amount of it will be invested in electrical industries of every kind and description.

"We have great confidence in the administration, believe that it understands thoroughly what is best for the interests of the country, and that great wisdom will be displayed in giving us a conservative government. If this be done, then nothing in the past will be equal to the development of the electrical business during the next two or three years."

PATENTS.

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Send me a model or drawing of your invention, and a description, and I will examine same and advise you promptly. My fees are moderate in all Patent matters, and I can obtain a Patent in the shortest possible time.

All patents taken out through me are given special notice in the leading journals of the country, thus bringing same widely before the public without cost to inventor.

REFERENCES: "Electrical Review," New York; Paul Cromlein, Teller Lincoln National Bank, Washington, D. C.; Judge Geo. D. Parker, Berkley, Va.; Second National Bank, Washington, D. C.; E. K. Leech, U. S. Mint, Philadelphia, Pa.; W. F. Newell, Manager and Secretary Water Works, Olympia, Oregon.

EDW. S. DUVALL, Solicitor of Patents. Loan and Trust Bldg., WASHINGTON, D. C.

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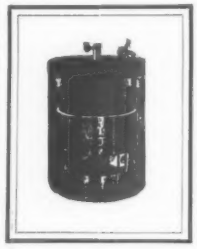

The increasing popularity of the Gordon Primary Cell among the Fire Alarm and Police Signal Service of the leading cities, the railroad, telegraph and telephone companies, and the general adoption of our steel enameled cell for gas-engine, launch and marine service attest most highly to its merit, efficiency, adaptability and economic features.

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Good Telephone Books.

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BY EDWIN J. HOUSTON AND A. E. KENNELLY.
The authors have prepared this book in the hope of enabling those who are not trained in electrotechnics to understand the main principles and method of operation of the telephone systems of to-day.
Price, $1.00.

"TELEPHONES, THEIR CONSTRUCTION AND FITTING,"
BY F. C. ALLSOP.
Description of Receivers, Transmitters, Switchboards, Complete Instrument Switches and Switchboards, Erecting Telephone Lines Overhead Wires, Instruments, Connecting, Testing for and removing faults.
256 pages. Illustrated. Price, $2.00.

"TELEPHONE LINES AND THEIR PROPERTIES,"
BY J. W. HOPKINS.
Contents: Design and Construction of City Lines.
Underground Work.
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The Propagation of Energy.
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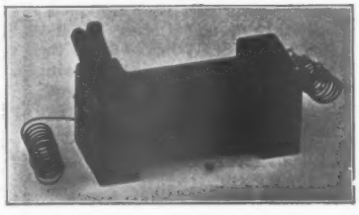

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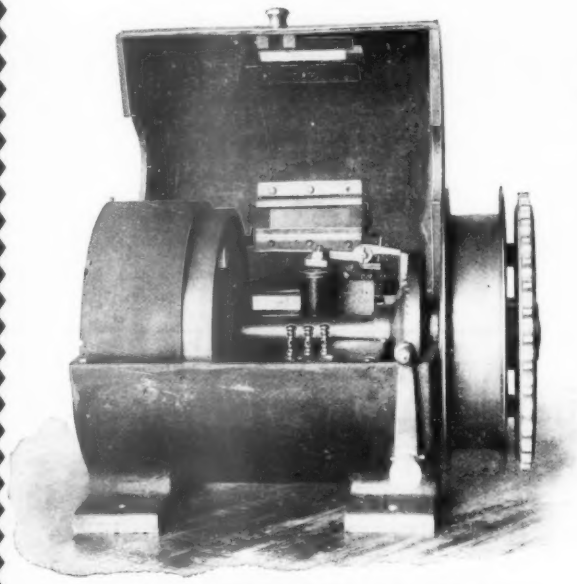

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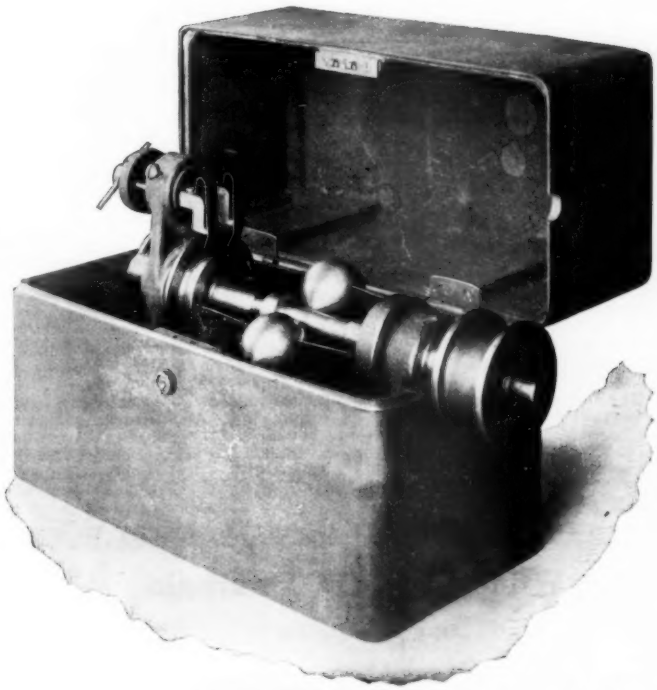

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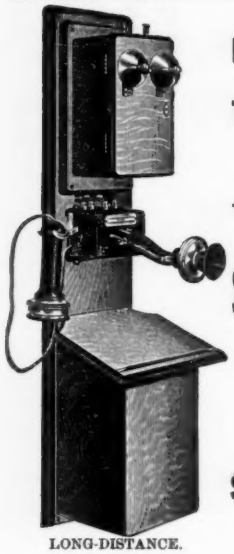

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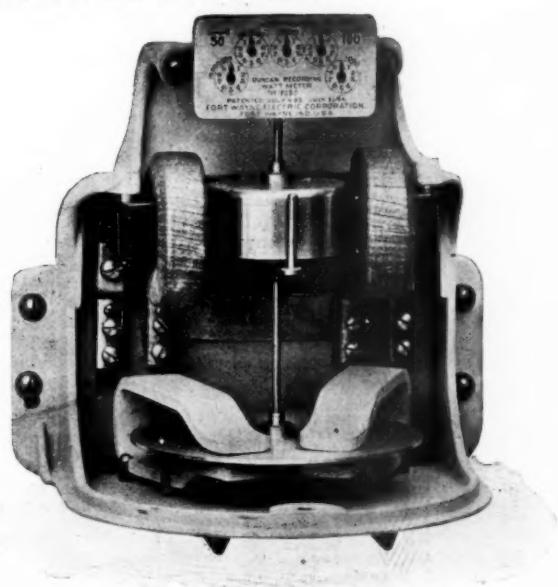

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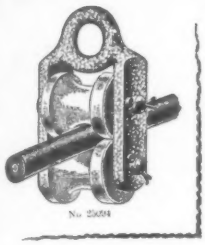

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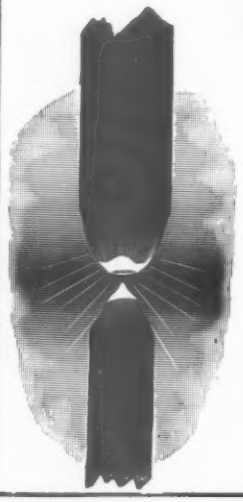

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